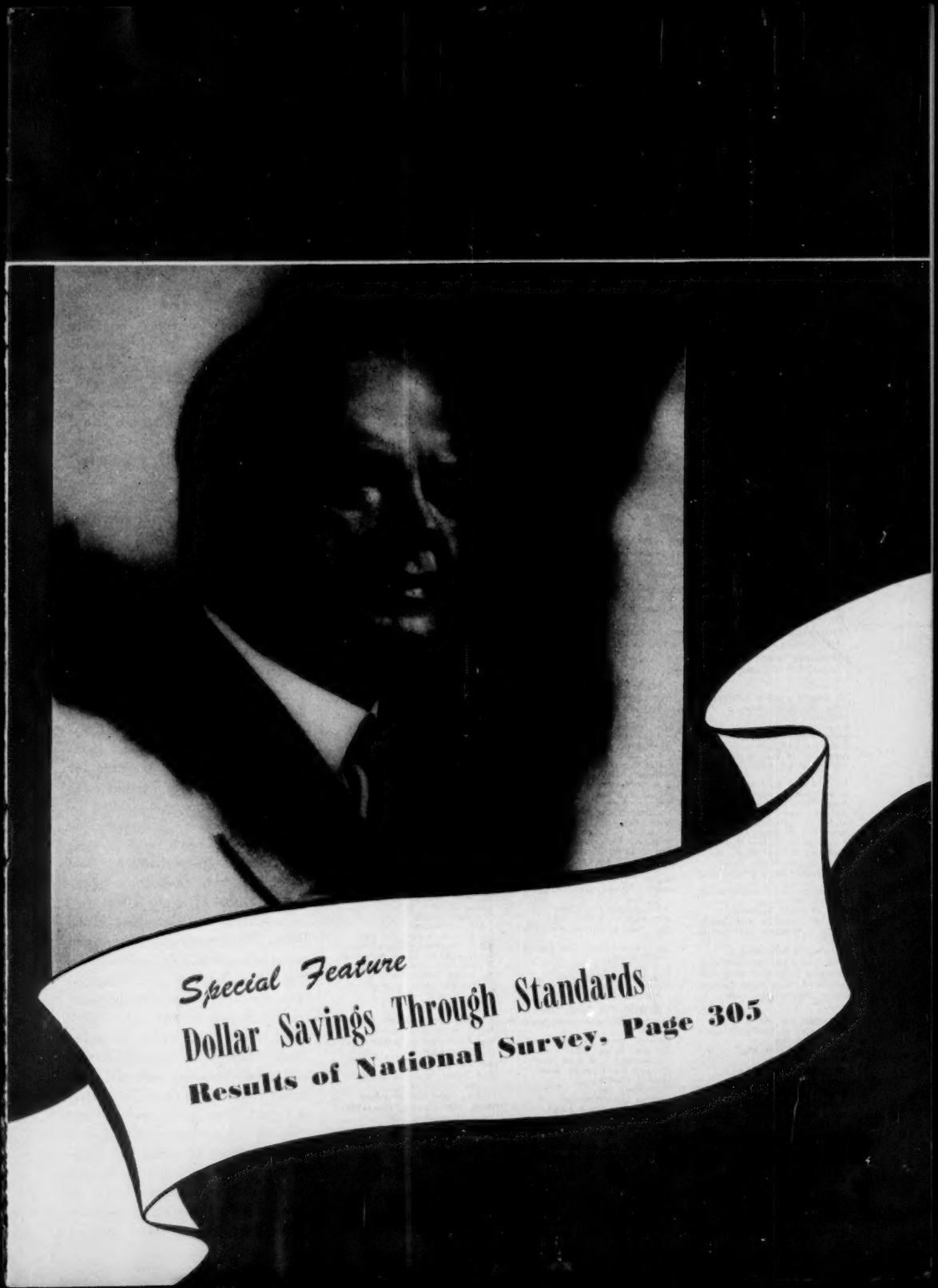
Special Feature
Dollar Savings Through Standards
Results of National Survey. Page 305

American Standards Association
Incorporated

Marginal Notes

Herbert Hoover—
1951 Howard Coonley Medalist

This year's Howard Coonley Medal goes to the Honorable Herbert Hoover, past President of the United States, and statesman extraordinary in the field of standardization.

"No American name is more closely associated with the standards movement in America than that of Mr Hoover," says Leon C. Stowell, president of the Underwood Corporation. Mr Stowell headed the award committee that selected Mr Hoover. "For more than half a century," Mr Stowell points out, "as a mining engineer, as a public official, and as a private citizen, Mr Hoover has worked to reduce waste, improve efficiency, and increase production through the techniques of standardization."

Mr Hoover first saw the possibility of advancing the nation's economy through the use of standards during the first World War. The experience of the War Industries Board in reducing the number of sizes and types of manufactured products, thus saving material and manpower, interested him. Foreseeing the need for similar techniques in peacetime, as well as in wartime, he stimulated the Federated American Engineering Societies to carry out a comprehensive study on "Waste in Industry," and he himself served as chairman of the committee that made the study.

As Secretary of Commerce in the 1920's, Mr Hoover gave impetus to the growing standards movement by creating a Division of Commercial Standards (now known as the Commodity Standards Division) which aided industry in its search for higher productivity. Its first accomplishment was to help manufacturers of paving blocks reduce their 66 different sizes to eleven (later five) standard sizes.

In 1941, the report of the Hoover Commission on reorganization of the Federal government emphasized the importance of standardization of government processes and methods, particularly in purchasing and ac-

counting, as a means of increasing efficiency and reducing waste.

The Howard Coonley Award is presented each year to an executive who has given outstanding service in advancing the national economy through voluntary standards.

Cover photograph—Fabian Bachrach

How Industry Saves with Standards—

Industry's answers to ECA's questions on its experience with standards were so outstanding and unusual that we have increased the size of this issue in order to make them available to you. The 32-page center section (pages 305-34) brings you this valuable report. "Standards are a good thing," everyone says—but try to pin down the proof in specific figures! For the first time, this ECA report does just this. Not only European industry, for whom the survey was made, but American industry as well, will find these figures invaluable in showing what can be accomplished through the effective use of standards.

Because we believe everyone concerned with standards will want this report on his desk for easy reference, ASA is also making it available as a separately bound pamphlet. A heavy paper cover will increase the pamphlet's durability and usefulness. E. A. Pratt, representative of the International Organization for Standardization at the United Nations, is to be congratulated on the fine job he did in compiling this report.

Apologies to Sonotone—

STANDARDIZATION is deeply grateful for the courtesy and help shown it by companies that contribute pictures to illustrate its stories. Seldom do we fail to give those companies adequate credit for their assistance. Last month the unusual happened. The pictures on page 283, September STANDARDIZATION, carried no credit line. We are pleased, here, to say to Sonotone Corporation, "Thank you for the two pictures used in illustrating our story on 'Accurate Measurement for Better Hearing.'"

Opinions expressed by authors in STANDARDIZATION *are not necessarily those of the American Standards Association.*

Vol. 22 No. 10 Standardization October 1951

Formerly Industrial Standardization

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Standardization is dynamic, not static. It means not to stand still, but to move forward together.

In This Issue

ASA

Reg. U. S. Pat. Off.

Ruth E. Mason, Editor Margaret Chamorel, Production Editor

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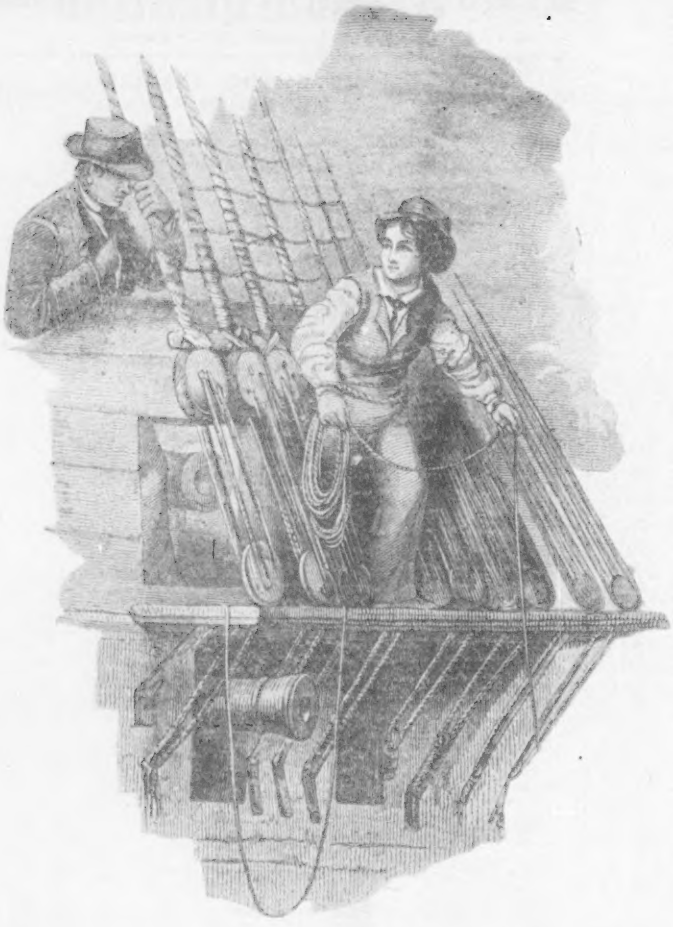

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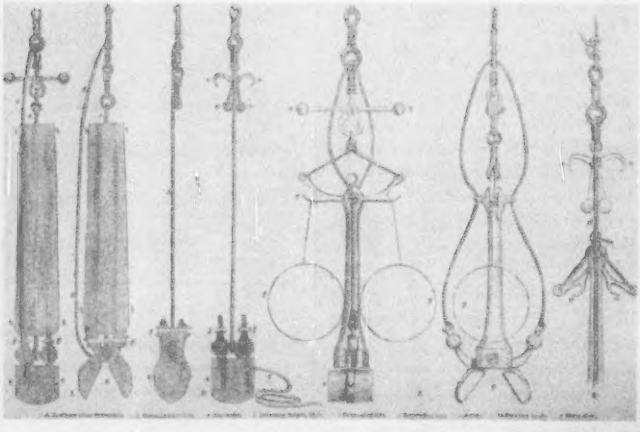


The ancient method of "heaving the lead" (above) has given way before modern science only in the last few years. As late as February 1861, this "improved machinery for deep-sea soundings" (right) was pictured as an illustration of up-to-date equipment. Now, the use of sound waves has opened a new undersea world, making it possible not only to chart the depth of the ocean but to discover its secrets as well.

The Language of Sound

"THE most useful modern instrument in a pilot house is the echo sounder, which measures the depth of the water automatically and continuously as the ship plows ahead at full speed."

This sentence from *Scientific American's* recent article "The Deep Sea Layer of Life"* may have nostalgic undertones for old sea dogs who regret the loss of more picturesque methods of sounding. However, it presents a graphic illustration of the way in which modern acoustical equipment is rapidly becoming an important tool in many industries as well as on the sea.

The use of sound on film, magnetic recording devices, and ultrasonic testing of materials, as well as underwater echo-ranging equipment all testify to the rapid development and growing commercial usefulness of acoustical techniques.

So new is this science that until very recently a number of the terms used in connection with recording and reproducing sound could be classed only as slang.

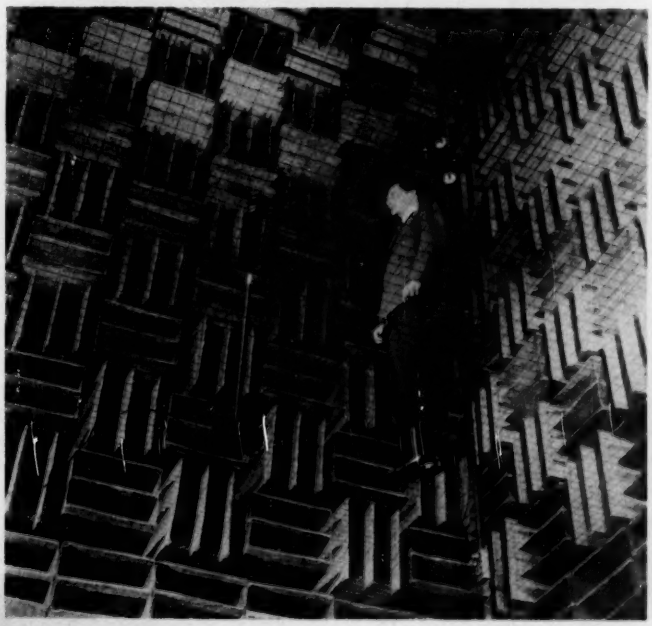
In July of this year, however, a new American Standard Acoustical Terminology, developed by agreement of outstanding acoustical experts in all fields, was sponsored by the Acoustical Society of America in cooperation with the Institute of Radio Engineers and approved by the American Standards Association. It provides a dictionary entirely devoted to the language of acoustics. Wherever the terms used are accepted widely enough to permit agreement they have been pinned down.

Two viewpoints on acoustics—subjective (how a sound is received inside the ear) and objective (what happens outside to produce the sound)—can be traced in the development of these acoustical definitions.

Before the Nineteenth Century the approach to acoustics was almost entirely subjective. Musicians and actors, as well as makers of musical instruments in general, were concerned largely with the effect of sound on the listener. Only a few individuals in each generation were interested in developing the scientific, objective principles on which sound could be controlled, measured, or produced for the benefit of industry and the population in general.

Late in the Nineteenth Century, Lord Rayleigh first put the science of acoustics on a mathematical basis. His two-volume book on acoustics still stands as a classic in the field. So sure was his work that, although the material he presented has expanded as new knowledge has developed, no changes have been made in the principles he laid down, and no new basic principles have been added.

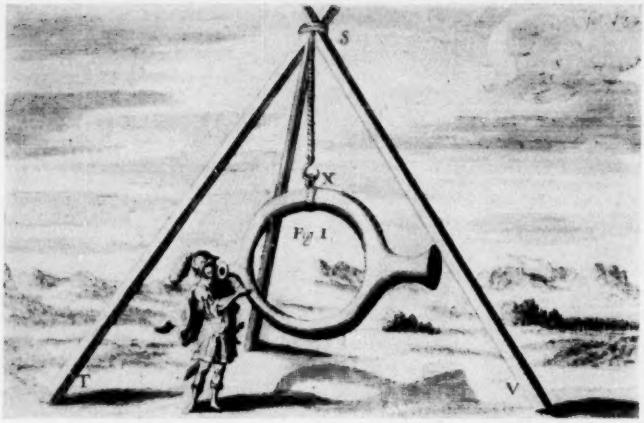
This objective science of acoustics was first put to practical use in the architectural field. Experiments on acoustics in auditoriums were made by Dr. J. B. Upham in 1853, and in 1854 Joseph Henry submitted a paper on the Acoustics of Buildings before the American Society for the Advancement of Science. The Nineteenth Century was not content with applying acoustical principles to the improvement of indoor sound reception alone, however. In 1872-73 ex-



Bell Telephone Laboratories

The ultra soundproof room is used for acoustical research. All surfaces which would reflect sound are lined to a depth of five feet with saw tooth wedges of fiberglass. Steel cables, 8/100 of an inch thick make the working floor.

* This story (*Scientific American*, August 1951) describes how modern "echo-sounding" equipment is charting the depths of the ocean. The story centers around the attempt to find out what causes the "deep scattering layer," the "sea's phantom bottom" which has been recorded by sonic equipment.



The Bettmann Archive

The "magic horn" of Alexander the Great, was supposed to have carried the commander's voice a distance of 120 miles. Without the mouthpiece, this amplifier is a duplicate of fire gongs found today in many New England villages.

periments were carried out in England to determine whether a gunpowder explosion could be made to provide a more effective foghorn to supplement the use of lights in stationary lighthouses and thus more adequately protect shipping in a dense fog. Work on foghorns brought to light the fact that objects cast an acoustic shadow.

It is a far cry from these comparatively recent, yet crude, experiments in the use of sound to the present-day echo-ranging techniques for locating schools of fish or for checking locomotive axles, magnetic recording for reproducing the human voice, or ultrasonic sound waves for homogenizing milk.

It is no wonder that the language of acoustics was still in a state of flux as late as 1931 and 1932. The modern science of electroacoustics started in 1917 with the development, by E. C. Wente, of the capacitor microphone which was of relatively high quality and dependability. This device as a measuring device, and loudspeakers covering the audible range, were developed in the late twenties and thirties.

Only since the late thirties have magnetic recording devices such as wire recorders, tape recorders, etc, become commercially available. And World War II contributed the echo-ranging techniques for locating submarines, now adapted for peacetime use.

As the science of acoustics was first applied in the architectural field, so the movement to standardize the language of acoustics was started by those interested in architecture.

Lack of standard definitions not only led to confusion on the part of readers of acoustical literature but also led to loose thinking on the part of the scientists developing acoustical technics. In architecture, for example, the term "absorption" might have referred to the amount of power absorbed when sound strikes a piece of material used in lining an enclosure. Or it might have referred to reduction in the sound pressure as a sound wave is reflected by a piece of material. Or, again, it might have been referred to the change in the length of time a sound would persist in a closed room lined with sound-absorbing material. Nor was it clear whether the term was being used in reference to a plain sound or a diffused sound wave. Because of this lack of definition, the importance of these factors in the measurement of acoustical properties was easily overlooked. (In today's dictionary of acoustical terms, "sound absorption" is defined as "the process by which *sound energy* is diminished in passing through a medium or in striking a surface." A square foot of perfect absorption has been given the name of one of the early experimenters in architectural acoustics—Sabin. And the term "sound-absorption coefficient" has been assigned to mean "the fraction of incident sound energy absorbed by the surface or medium." The time required for a sound to decrease after the source of the sound is stopped is known as "reverberation time." A room designed to absorb sound, sometimes called an "anechoic chamber," is given the name "dead room.")

Bell Telephone Laboratories

First coast-to-coast television hookup (new microwave radio relay) carried the Japanese peace treaty conference.

Work on acoustical standards was started in 1932, when a committee was set up by the Acoustical Society of America to work on terminology, scales, and methods of measurement. As a first requisite the committee started with standard definitions of the terms to be used. Organized under the procedure of the American Standards Association, this committee brought together scientists and technical experts from every important group concerned with the science of acoustics. It came out with tentative standard definitions in 1936. This was followed in 1942 by a revised and expanded edition.

Both these editions went as far as they could at the time in codifying the terminology and definitions that could be agreed upon. As far as architectural acoustics is concerned, the science was well enough advanced

by 1936 so that no new changes were found necessary in future editions. In other fields, however, rapid advances have been made even in the last ten years. For this reason, the 1951 edition of the American Standard Acoustical Terminology, just completed, includes a number of new sections—on recording and reproducing, and on underwater sound, for example—and greatly expanded material in a number of other fields.

The new edition was prepared in cooperation with the Technical Committee on Electroacoustics of the Institute of Radio Engineers. Through this cooperation the IRE definitions of electroacoustical terms and those in the American Standard are in agreement. The American Standard also agrees wherever applicable with the American Standard Definitions of Electrical Terms which is now being revised under the sponsorship of the American Institute of Electrical Engineers. In the sections of the new standard on sound transmission and

Bell Telephone Laboratories

Here is an electrical analogue of the human vocal system, a device used to study speech sounds in operation.

transmission systems for example, the terms are essentially identical with those used for electrical circuits.

This follows an historical pattern. Early electrical workers adapted for their own use the mathematics and terminology developed for the science of mechanics. In developing theoretical acoustics, acoustical scientists in turn borrowed and adapted electrical terms and equations. With the advent of electroacoustic devices, an even closer similarity in terms and techniques became evident.

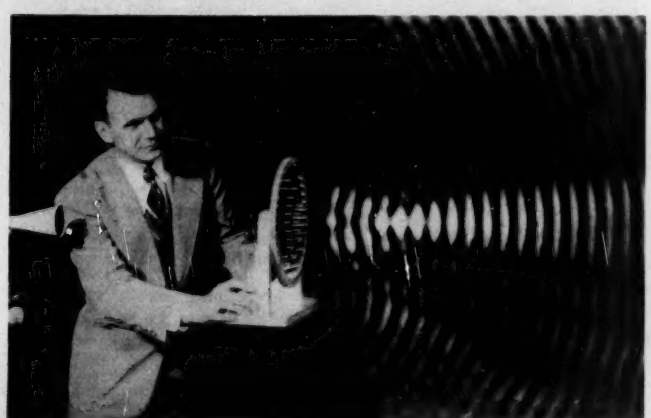
This article was prepared in cooperation with C. F. Wiebusch, W. D. Goodale, Jr., and M. S. Richardson of Bell Telephone Laboratories. Dr. Wiebusch is chairman of the combined IRE Electroacoustical Committee and ASA Subcommittee Z24A on Acoustical Terminology; Mr. Goodale and Mr. Richardson are co-secretaries.

"Ultrasonics" is defined in a new section in this edition as sound "in the frequency range above about 15 kilocycles per second."

"Supersonics," therefore, is recognized as "phenomena associated with speed higher than the speed of sound." These terms have frequently been used interchangeably. The section on ultrasonics not only includes a great many terms common to ordinary sound and to transmission systems and components but brings in a number of new concepts. The knowledge of ultrasonic principles developed rapidly during World War II. Since the war, individuals who had worked on submarine detection have developed many peacetime uses for the methods and principles learned under wartime conditions. The use of ultrasonics in testing steel, rubber, and similar materials makes it possible to check on the strength of these materials without testing to destruction. Because of its very recent development, only a small part of the language associated with the science of ultrasonics has been codified.

This section is closely related to the section on underwater sound. Definitions of the terms applying to use of ultrasonics in locating objects and measuring distances under water are complemented by data on standard sea water conditions. The standard values have been chosen to represent closely the average conditions on continental shelves except in tropical waters. Since salinity of the water varies, the data are intended to establish consistent relationships between acoustical quantities which involve the properties of the sound medium. A table showing representative water conditions is included.

Despite the fact that hearing and speech may be considered the oldest and best established of any field of acoustics, the section on "hearing and speech" includes several important changes in bone concepts. The term "phonetic speech power" which called for a test for 1/100 second, is not in the present edition. The interval of time is no longer considered important. The definition of "threshold of audibility" outlines in general terms the method of determining the "minimum effective sound pressure . . . that is capable of evoking an auditory sensation . . ." The earl-



Bell Telephone Laboratories

A demonstration of the focusing effect of an acoustic on sound waves emitted from the horn at left. Scanned by a tiny microphone and a 110-volt neon lamp on a swinging beam, the wave pattern at right was produced.

ier edition expressed this concept in terms of the sound pressure of a sinusoidal wave. The new edition permits other methods as well.

Many of the terms used by the medical profession in checking and treating hearing deficiencies are included.

The industrial use of acoustics has been taken into consideration in the standardization of the term "mel" as a unit of pitch and of "sone" as a unit of loudness. These are subjective units which reflect the listener's reaction to changes in frequency and sound intensity. No longer is it necessary to calculate pitch and loudness on a logarithmic scale. Both the mel and sone are calculated on an arithmetical basis. Thus, if a sound rises to twice its original pitch, the new pitch can be expressed in double the number of mels. If a sound increases three times in loudness, it can be expressed in three times the number of sones.

Bell Telephone Laboratories

An early type of tape recorder. The steel tape records the message and the reproducing machine plays the message back through the loud speaker at the right in background.

The subjective and objective approaches to acoustics are rightly combined in the section on "Music." Here many alternative definitions are given, reflecting the different approach of the musician, psychologist, and the scientist. "Tone," for instance, is defined as both a "sound wave capable of exciting an auditory sensation having pitch," (reflecting the scientist's objective viewpoint) and as "a sound sensation having pitch" (reflecting the musician's and psychologist's subjective interest).

Musicians and manufacturers of musical instruments will be glad to know that in the 1951 edition the standard pitch of A above Middle C is maintained at 440 cycles per second. Several years ago this standard seemed to be threatened when the Austrian delegation to UNESCO proposed international adoption of 435 cps. However, 440 cps already had been widely accepted as an international standard on recommendation of a committee of the prewar International Standards Association. In Great Britain it is broadcast each morning as a guide for British musicians and in this country it is broadcast frequently by the National Bureau of Standards over its radio station WWV. This use of the 440 pitch may be considered a triumph of instruments over voice, since calls for a lower pitch mostly come from countries where operatic singing is a specialty. A singer who can reach high C when A is 435 cps may crack if she tries the same high note at 440 cps. American jazz bands are credited in some quarters with responsibility for the 440 standard pitch. Fearful of being considered flat, they tuned up their instruments higher and higher on the sharp side. Standardization of the pitch at 440 in the 1936 edition of the American Standard Acoustical Terminology arrested this tendency toward higher and higher tuning—a boon to piano manufacturers, particularly.

The standard not only defines acoustical terms used in music but also provides tables of intervals (just intervals, small intervals, and equally tempered intervals), as well as frequencies of the tones of the usual equally tempered scale based on the A of 440 cycles per second.

The list of terms on recording and reproducing—an entirely new section—is the largest in the book, recognizing up-to-date developments in the field. It defines such terms as "playback," "mixer," "de-emphasis," "dubbing," as well as the various types of instruments, different kinds of noises, and methods used. Direct mechanical recording of sound on phonograph records goes back to Edison's work, as early as 1900. However, the wide commercial use of electro-acoustic recording is so recent that these standard definitions serve to codify the terms used for the first time.

So much work has been done recently in the development of acoustical apparatus that an entire new section has been devoted to terms used in connection with acoustical instruments.

Shock and vibration definitions are also given in this edition—the only material of its kind on the subject.

Recognizing the trend toward the use of the meter-kilogram-second system of units, the standard provides a conversion table to help in converting cgs acoustical units into the mks system.

In addition to the terms used in only one field, which are listed in the individual sections, a general section defines terms used in more than one field. "Reverberation," for example, used to apply only to architecture; now it is also used in connection with underwater sound. "Frequency" applies to every one of the specific fields. For this reason, the general section must be used in conjunction with each specific section.

Dollar Savings Through Standards

REPORT *of survey to obtain data on savings derived from the use of standards by American industry.*

Foreword

In each of the two great emergencies through which this country has passed in the present century, the utility of standardization has been emphasized. This is especially true in the present mobilization of the national economy. Restrictions on the use of materials, the employment of substitutes, and limitations of a variety of products are now beginning to be felt. Attention is being focused on standards as a means of stimulating production with the least possible disturbance of established and orderly practices.

Dollar Savings Through Standards is an attempt to compile a body of measurable proof in terms of dollars or percentages of net savings and specific economic benefits attributable to standardization. The first survey of its kind, it represents 140 documented case studies, covering 81 industries and industrial products. Most of this information was supplied to the Economic Cooperation Administration through the American Standards Association, which got it in a special survey of its 110 trade association and technical society members, and 2,000-odd company members.

In its drive to sell increased productivity to Western Europe, ECA's Productivity and Technical Assistance Division has pushed standardization as one of the techniques of American industry most likely to be bought, used, and profited by. This volume of documentary evidence shows what standards can do for the industry that uses them. Not only in this country, but in other industrialized nations now standing with us, the need is felt to utilize every available means of increasing our joint production. There is identity of interest among all Marshall Plan countries in this respect. The extent to which American experience can contribute has already been demonstrated. Much has been accomplished, but there is more to be done.

ASA undertook this survey to ascertain the economic savings resulting from standardization as a service to American industry, as well as a powerful means of bringing about the adoption of efficient practices in other countries on whose production the United States must rely in no small degree to conserve our own productive capacity. As a member of the 31-nation International Organization for Standardization (ISO), ASA has a further interest in presenting the points of view of American industry to industrialists of other countries. It was felt that this report would make an important contribution to the literature in the field of international standardization.

The report reveals a sharp rise of the standards movement since the war, particularly in the past two years. Company after company refers to recently installed standards programs. Others speak of programs not yet completed or about to be started. Such phrases are common as, "the full impact of this specification has not been felt," "we are still in the early stages of this program" —"we have only partially obtained our goal to standardize." The report throws some light on the vast amount of work that still remains to be done in standards. A typical comment comes from a chemical manufacturing company which writes, "You are of course aware that standardization of chemical equipment is in its infancy." A manufacturer of carbon brushes for electric motors and generators states, "There is still room in our industry for considerably more standards and with the cooperation of motor and generator designers, this would result in large savings to the user." And an equipment manufacturer declares, "We believe that a further standardization in the hydraulic equipment group would enable the purchaser of machinery and hydraulic equipment to derive ultimate savings in cost and reduction of service parts."

The most obvious generalization that can be drawn from the results of the survey is that standardization is truly an essential element of the American industrial system. Another important observation is that standardization programs in all degrees of development are currently to be found. The cases show various stages, ranging from elaborate and well established procedures to initial or tentative efforts. The larger the industrial establishment the more important it is that the fullest possible use be made of standards at every stage of the productive process.

In several instances it appears that the decision was reached at an early date that standards were essential; thereafter there was no further question as to their utility, and records of specific savings were not kept. For instance, a large manufacturer reported that economic savings could

not be itemized because the necessary information was not available, but after describing the company's early experiences said: "At this stage of our standardization work the 'economic net savings' were very apparent and we were completely 'sold' on its value." On the other hand, another very large establishment maintains an accurate record showing the extent of application of its standards and the annual savings attributable to their use.

Availability of information on savings appears to be largely a matter of the extent to which each company's cost accounting system takes into consideration the economic aspects of standardization; every gradation in this respect is represented by the cases cited—from no records at all to the most detailed accounts. An interesting example of a special analysis of savings for a specific item (springs) is described in Case 128. The Association of American Railroads has proposed a standardized accounting method for recording the benefits of standardization (Case 78).

Many examples of savings derived from the use of standards are to be found in periodicals and other publications of the past 25 years. Some of these have been included in the "cases" described in this report, where they are particularly appropriate, or where they serve to show what large savings can sometimes be obtained by standardization of a minor nature. The importance of early examples of savings is enhanced by the fact that in a number of the "cases" it is emphasized that savings due to the use of standards are cumulative, and that present savings are the outcome of standardization begun many years ago. When comparing early and recent cases the relative purchasing power of the dollar should be kept in mind; taking this into consideration, the earlier savings might be twice as significant as the figures would indicate, aside from their cumulative effect.

A check list accompanying ASA's request for information was returned by 61 companies, either with explanatory letters or alone, marked to show the fields of standardization in which savings had been achieved.

Analysis of these lists yielded the following:

1. The greatest number (over 15 percent) derived savings from reduced inventories of materials, parts and end products. Nearly the same number (72 percent) listed purchasing "larger quantities of fewer items" and the use, in engineering, of "accepted standard specifications" vs. special specifications" as sources of savings.
2. The next greatest number (67 percent) gave "buying most economical quantities," use of industry, national, or other standard specifications," and "variety reduction and interchangeability as sources from which they had derived savings.
3. With the exception of economies derived from modular coordination the remaining items of the check list were marked by from 26 percent to 54 percent of those returning the list. Of these items, "fewer materials and smaller variety of parts" and "minimum storage and warehousing costs," stood highest; "economies of special-purpose machines" was lowest.
4. Ten percent indicated that they had derived savings from "modular coordination."
5. Forty percent of the lists returned gave credit to standardization for "improved inter-departmental coordination."

While the number of returns on which the foregoing notes are based is not conclusive, the broad industrial coverage represented is significant. However, it should not be overlooked that the most substantial contributions to the survey, and those from the largest establishments, came from correspondents who did not return the check list.

A word of caution is necessary on one point: the adoption of a "standard" for any item—whether it be a material, a test, a procedure or a product—necessitates the elimination of all "non-standard" varieties of the item. The extent of this elimination is frequently mentioned in the cases described; it is a rough measure of the degree of standardization. However, this limitation of variety is generally an "ex parte" sort of standardization — conducted exclusively by the user, without concurrence of any other parties. Much troublesome misunderstanding will be avoided if this fact is borne in mind, and it is clearly realized that these variety limitations have little significance considered apart from the standardization of which they are a result.

The "cases" have been roughly divided into groups under such headings as "mechanical manufacturing," "machine tools," etc, some of which are necessarily duplicated in Section IV, Supplementary Cases. However, it is obvious that many industries which differ a great deal in the nature of their products still utilize identical standards for items like industrial fasteners, screw threads, etc.

Attention is particularly directed to the full indexes, which are to be found at the beginning of this report. The first index is a list of the reporting industries, arranged alphabetically, showing the corresponding case numbers. The second index is a list of the various subjects of standardization discussed in the cases, arranged alphabetically by subject, and showing the corresponding case numbers. The specific interest of the user of the report will determine which index is applicable.

Individual copies of this document at $1.00 each can be obtained from the American Standards Association, Incorporated, 70 East 45th Street, New York 17, N. Y. ECA is distributing the report abroad; in this country, copies can be obtained only through ASA.

I. Index of Cases

Alphabetical—According to Industry Reporting

II. Index of Cases

Alphabetical — According to Subject of Standardization Discussed

Check List of Savings Resulting from Standardization

(The following "check list" was distributed to those who were asked to report on their experience with standardization. It served as a guide to the type of data that might be included in the reports. References to the "check list" are found throughout the Cases.)

SAVINGS IN

Procurement

- Larger quantities of fewer items
- Buying most economical quantities
- Use of industry, national, or other standard specifications
- Reduced volume of accounts, payments, records, etc.
- Elimination of disputes
- Broader competition among suppliers

Engineering

- Variety reduction and interchangeability
- New designs more readily coordinated with existing products
- Economies of "modular coordination"
- Standardized drawings and drafting room practices
- Accepted standard specifications vs. special specifications

Manufacture

- Fewer materials and smaller variety of parts
- Longer runs—continuity of operations
- Uniformity of operations—simpler training
- Easier inspection
- Improved quality control
- Maximum mechanization
- Economies of special-purpose machines
- Quick interchangeability of machine parts in event of breakdown

Distribution

- Concentration on reduced variety of products
- Time element of deliveries
- Simplified training of personnel
- Packaging and materials handling
- Simplified servicing

General

- Reduced inventories of materials, parts and end products
- Minimum storage and warehousing costs
- Most effective use of all physical plant
- Simplification of office work
- Improved inter-departmental coordination

ABBREVIATIONS

AAR	Association of American Railroads
AIEE	American Institute of Electrical Engineers
AISE	Association of Iron and Steel Engineers
AISI	American Iron and Steel Institute
API	American Petroleum Institute
AREA	American Railway Engineering Association
ASA	American Standards Association
ASAE	American Society of Agricultural Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
AWA	American Warehousemen's Association
EEI-NEMA	Joint Committee—Edison Electrical Institute - National Electrical Manufacturers Association Joint Committee
FEI	Farm Equipment Institute
RTMA	Radio - Television Manufacturers Association
SAE	Society of Automotive Engineers

III. CASES

Mechanical Manufacturing

It is, no doubt, in the field of "mechanical manufacturing" that American industry derives the greatest aggregate benefit from the use of standards.

The field of mechanical manufacturing has had the longest experience with industrial standards and has probably seen the greatest growth in their use. Contributions to the survey by several of the largest establishments in this field are therefore of exceptional interest, constituting, as they do, over-all pictures of the development of industrial standardization in the United States during the past thirty years or more.

The following letter from a large manufacturer of agricultural and automotive machines is one of these contributions:

CASE 1 *"Utility of Standardization*

"Our first efforts in standardization began shortly after the formation of the company and for many years were localized in the various works. The desirability of a centralized control over these activities was soon recognized, and a little over 31 years ago a committee was formed to review and coordinate the most important local standards covering parts and materials specified by the several engineering departments for use in the end products. Many of these early standards antedated those that are now recognized as 'National' or 'American,' and in a number of cases the parts were made in our own works because they were not commercially available. At this stage of our standardization work the 'economic net savings' were very apparent and we were completely 'sold' on its value.

"At the present time the size of the company and our divisional organization have combined to bring about a change that I suppose must be called 'decentralization.' The demands for standards have increased to such an extent that one committee could not do full justice to the assignment, and departments other than Product Engineering became involved. The original committee has been split into 'Standards' and 'Materials,' the former in our Manufacturing Research Department that has control over the standardization of tools, materials, processes, etc, used in the manufacturing operation at all works. There is, of course, close cooperation between these committees, and in some instances the same men are members or regular conferees on two or more.

"Many of our original standards have been revised to conform to the 'National' standards as they were issued. In some cases only the basic dimensions have been retained, and particularly on parts that we manufacture, the tolerances are to suit our own requirements and manufacturing facilities. We still make a variety of fasteners to our own standard specifications because we have found them satisfactory and they cannot be purchased from outside sources. Our standard parts book contains a selection of pages copied from the General Motors Engineering Standards to which have been added pages covering parts peculiar to IH, parts not shown by GM, or parts for which our standards differed radically from those of GM. A very high percentage of all these standards are in exact accord with ASA, SAE, etc. Some of the savings we obtain come from a reduction in the types of recognized standard bolts and the adoption of only two grades of bolt, thereby simplifying the purchase of material and the heat treating operations. For example, we have only *one* hexagon head bolt, and as we require the #3 plow bolt it has been found possible to substitute this for the countersunk carriage bolt.

"Quite a few H—— men take an active part in various standardization activities outside the company and are members of different ASA, ASAE, ASME, ASTM, SAE, and FEI committees. Many of the standards adopted by these committees and other committees are used by the company, and the writer is personally familiar with several as follows:

ASA —screw threads, practically all fasteners, many tools, pipe, many ferrous and non-ferrous metals, abbreviations for use on drawings, and many of the safety standards.

ASAE—hydraulic remote controls, power take-offs, tractor belt speeds, and V-belt drives for agricultural equipment.

SAE —drafting standards, and a variety of parts and fittings.

"Copies of all IH Standards are circulated to the eighteen works of the five divisions that are responsible for the design and manufacture of our machines. In addition to these works in the United States there is a Canadian subsidiary and several manufacturing plants in foreign countries. Our standards are used wherever possible but in Europe it has been found necessary to make many changes in order to conform to local practice. The decision with respect to the adoption of standard parts, materials, etc, is the responsibility of the managerial organization at the works. Our product engineering departments are instructed to follow the standards wherever possible and to consider the design of special parts only as a last resort. Periodic cost reduction campaigns often result in a wider use of our standards, and the records scattered throughout the various works prove conclusively that standardization does save money.

"The emphasis now placed on conservation of material has brought about an important change in our bolt standards which recently have been revised to include under-size bodies for specific types and sizes. It is estimated that this change will result in an annual savings of several hundred thousand pounds of steel at the works where these bolts are made. The current production of critical

alloy steel parts has been possible only by recent development and standardization of new steels in which scarce alloying elements have been replaced by boron. The rapid standardization necessary in this instance was effected by our Materials Committee and by company representation on the SAE Iron and Steel Technical Committees."

Another large manufacturer, with a somewhat more varied line of products, describes its experience with standardization:

CASE 2 "Perhaps the greatest degree of standardization has had to do with purchased materials. A rather complete set of material specifications bearing W——'s designation, but, technically, based on the corresponding standards developed by the various national societies, such as ASTM and SAE, is used throughout the Corporation. These, in loose leaf book form, aside from serving as reference sheets for engineering, facilitate purchasing in that standard materials may be purchased in larger quantities and the transfer of excess inventory from one plant to another simplified.

"A book of welding standards, based on the symbols and practices developed by the American Welding Society, but detailed to suit W——'s particular requirements as to rod sizes, speeds, etc, has also been developed and is used by the various plants interested in such work.

"Contemplated Corporation activities have to do with a greater degree of standardization in such matters as bolts and studs, their fits and clearances, bearings, springs, and the possible concentration of the manufacture of such items in the particular plant best suited by usage and/or facility to produce them. This work will be carried on by a Manufacturing-Engineering Committee with representation from the various plants meeting as necessary to discuss such matters. The natural tendency will be to utilize, as far as practical, those standards which have been approved by the American Standards Association.

"The individual plants have accomplished much in standardizing the various accessories associated with their respective products. This is taken care of, usually, by a Standardization Committee made up of representatives from the various departments, which meets regularly to discuss such matters. In one instance, however, the work is carried on by a permanent Manufacturing - Engineering group which reviews the designs prepared by the Engineering Division with a view to harmonizing the detail with current shop practices and to utilizing, where practical, existing parts.

"A typical example of plant standardization is the recent development of a new line of pumps at Harrison Works. Through a careful analysis of the design detail it has been possible, through the manufacture of some 450 individual parts, to provide several hundred combinations of mountings, material arrangements, pressure heads, and capacities. This new line will replace, and do a more efficient job than, several older designs now utilizing some 3,000 parts. The study is being extended to include other lines. The potential savings to W—— as a manufacturer and to the user through greater flexibility and an appreciable reduction in inventory spares, is considerable. However, due to the fact that W—— is still called upon to furnish parts for pumps made forty and fifty years ago, some time will elapse before the savings are fully realized.

"Another activity inaugurated by Buffalo Works, which makes for greater operating efficiency, is the adoption of a standard nomenclature for identifying and recording parts. By a careful selection of part names and an associated numbering arrangement, reference drawings of previously made but similar parts may be quickly located in the files by engineering when special jobs are being considered. This tends to promote a greater use of existing patterns, tools, and dies, and, also facilitates the uniform setting of incentive rates through the same easy reference. Prior to this correlation the tendency was for engineering to design new parts rather than search through a maze of drawings to find something that might be useful. While the adoption of any new system naturally invites some initial confusion, the potential savings warrants the absorption of the occasional error.

"A case of a rather highly standardized product tending to work in reverse, because of the present emergency, is our line of W—— chemical pumps. W—— has for some time manufactured a stock line of chemical pumps in a proprietary alloy which contains considerable percentages of nickel, chromium, and molybdenum and which has excellent resistance to the corrosive attack of a wide range of liquids. Despite the higher material cost, it has been more economical to produce a standardized line in the one alloy than it would be to produce various, smaller lots of different materials suitable for specific chemicals. Because of the flexibility made possible by this highly resistant alloy, many of the chemical companies have standardized on W—— since pumps may be shifted from job to job and, hence, fewer required. Now, however, because of the present scarcity of alloys, it appears necessary that we abandon, except for essential services, the single alloy principle and revert to the older policy of producing pumps in various materials with the least alloy to meet the particular requirement."

Power Generation

An example of great savings derived by purchasers of standardized equipment in the composite mechanical-electrical field is described in the following letter from a large Engineering Corporation:

CASE 3 "We wish particularly to mention the ASME-AIEE Preferred Standards for Large Turbine Generators. The adoption of these standards has enabled the manufacturers to make tremendous savings in the engineering costs of producing large turbine generators, and these savings have been passed on to the consumer. An even greater saving of time, effort, and money accrues to the designing

engineer. At this time when engineering talent is one of our scarcest commodities, a long period of waiting arises between the purchase of a nonstandard turbine generator and the receipt of sufficient information to proceed with the design of foundations and the connected piping and wiring, whereas in the case of a 'preferred standards' unit, we already have complete erection drawings in our files and can proceed immediately and without delay to lay out the entire generating plant.

"We venture to say that at least one million dollars has been saved in the cost of equipment and the cost of engineering by our clients since V-J Day by our widespread use of 'preferred standards' turbine generators. This does not include any attempt to capitalize the value of the time which has been saved and which, in many instances, is even more important than the dollar saved."

In the field of steam power generation a substantial saving in manufacturing costs was obtained by standardization of certain elements in a product, as described in the following letter:

CASE 4 "The standardization of height of heating elements in the hot end of our preheaters is the best example of savings that can be cited in our experience.

"In order to obtain exactly the required amount of theoretical heat transfer, our sales engineers proposed to vary the height of the hot end elements by increments of 2 inches.

"After a protest from the Shop and Purchasing Department against stocking so many different widths of material, a study was made which resulted in obtaining better performance, more flexibility as to amount of heat transfer, and lower replacement costs to our customer by furnishing two or three layers of elements in each heater. The cold and intermediate layers were graduated in increments of 2 in. while the hot end layer was graduated in increments of 4 and 6 in. As a result we eliminated four widths of material 30, 34, 38, and 40 in. per following tabulation:

8	Cold end	19½	Hot end—4 heights eliminated
10		23½	
12		27½	
		30	Eliminated
		32	
14	Intermediate	34	Eliminated
16		36	
18		38	Eliminated
		40	Eliminated
		42	

"This cut our required inventory by 25 percent. We are limited as to storage space and it would have been necessary to purchase in standard wide widths and slit to specified width. Slitting costs $12.00 per net ton plus trucking cost to Buffalo and return.

"On an average consumption of 600 tons of sheet per month this would have cost us 25 percent of 600 tons x $12 or $1800 per month
Trucking cost 200 miles $4 per ton $600

Total Saving $2400 per month

Machine Tools

The machine tool industry has benefited from standardization for many years, though some of the outstanding examples are of recent date. The General Manager of the National Association of this industry writes:

CASE 5 "There isn't any question of the fact that every machine tool builder has profited in his own plant from standardization.

"Even more important, however, is the saving to his customer. When a machine tool user can take the chuck off one engine lathe and put it on another, although the second one is a different make, it simply means that he doesn't have to have two chucks in his tool room.

A manufacturer of air tapping, drilling, and threading equipment gives the following example of economies derived from standard tooling methods.

CASE 6 "As a machine tool builder, we early recognized the fact that utilization of the maximum productive capacity of our machine was dependent upon the efficiency of the tooling used. It has been our experience that there is entirely too much time and expense involved in the normal procedure of tooling design—developing fixtures from the ground up for every job. Certain portions of these fixtures do not require detailed layout. Many basic common elements can be standardized. More time can be spent in initially working out basic mechanisms incorporating automatic or semi-automatic features that have wide application for drilling, tapping, threading, milling, etc. Subsequent adaptation of these standard mechanisms to individual requirements can be made with minimum effort and cost. We proceeded in this manner:

"*Master* Fixtures were developed for handling various types of parts in an efficient manner; and versatility was obtained by the use of inexpensive adaptors, jaws, or plates that permitted quick change-over from job to job merely by adjusting or replacing these parts on the basic fixture. As additional applications were recognized, these, too, were developed as a standard item.

"The result has meant a saving of hundreds of thousands of dollars to our customers as well as to ourselves.

"From our viewpoint, it has allowed us to:

Produce these Master Fixtures in quantity on a production basis.

Eliminate the tool engineering department.

Eliminate detailed and costly drawings for tooling.

Simplify cost estimating and quotations.

Provide the most efficient methods of processing similar types of special tooling.

"For the customer, it has provided:

Highly productive tooling at a minimum cost (even for short-run jobs.)

Versatility and adaptability of tooling for other work.

The advantages of experience on many previous jobs of the same nature.

A standardized fixture for which replacement or repair parts are always available.

The maximum efficiency of operation from his machine.

"The simplicity of tooling any Master Fixture often allows the customer to make up his own adaptors for the fixture for other jobs."

A producer of nonferrous metal gave the following example of saving in the cost of angle cutters.

CASE 7 "Fifty-seven types of special angle cutters for machining dies have been reduced to 28. The larger quantity of each type purchased, plus group buying for all the plants, has resulted in a saving of approximately $10,000 a year on these tools alone."

A manufacturer of drilling, boring, facing, and tapping machines writes:

CASE 8 "In manufacturing special machines, it is sometimes quite difficult to predict just how many given items will be required in the succeeding period. Therefore, large savings because of increased ordering volume are not easily realized.

"We do feel very confident in saving, however, that we have realized the savings as marked on the attached check list with which you supplied us.

(Savings indicated for about half of all the items in the check list)

"Our Engineering Standards Department is relatively new and up to now has concentrated primarily on small materials. For your interest, and to whatever use you may want to make of it, we are also enclosing a partial list of some of its accomplishments."

(List of standardized items includes screws, nuts, pins, oil seals, bronze bushings, hand wheels, flexible couplings, and screw threads)

The recent standardization of four shades of gray finishes for industrial apparatus and equipment (American Standard Z55.1-1950) lends point to the following record of loss arising out of non-standard colors for machine tools.

CASE 9 "A $25,000 machine tool waited four weeks for a can of paint so that it would match other tools in the factory of the same purchaser. The interest charge alone amounted to about $125."

Automotive

The American automotive industry is perhaps the most outstanding example of an industry whose growth has been to a great degree the result of the economies of mass production in which standardization is recognized as essential to economical manufacture.

The money savings due to the use of standards have been variously estimated in general terms and by specific items. The President of the International Committee of Scientific Management stated, in 1938, that:

CASE 10 "Figures show that in one year's output of American automobiles over $800,000,000 was saved for the manufacturers, and of course in cost to the public, because of the large number of minor parts that have been standardized."

Some specific savings from the use of Society of Automotive Engineers (SAE) Standards are the following:

CASE 11 A large automotive vehicle manufacturer reported that standardization of nuts resulted in a savings of $500 per day in this one item.

CASE 12 A large motor manufacturer reported that a record was kept of the number of hexagonal head screws used in the various models which they built. The reduction in cost after standardization was $52,758.96 in one year.

CASE 13 Ball bearing and electrical equipment manufacturers state that SAE standards have reduced production costs over 20 percent.

Standardization of machine tools and other equipment used by the automotive industry has, in several instances, been developed by a joint Industry Conference (JIC), comprising representatives of the automobile manufacturers, the companies supplying equipment to the industry, and the associations and societies concerned with the automotive field. The following report from an equipment manufacturer contains a reference to such standards.

CASE 14 We have made a survey of our facilities in an effort to determine what standardization we have introduced in the last 5 years, and what benefits we have derived from it.

"We have revised our engineering standards to conform with the engineering standards set forth by the U.S. Air Force. We have redesigned our products in an effort to standardize parts for interchangeability, and reduce the number of parts for service. We are, at present, redesigning our equipment to conform to JIC Standards set forth by that committee recently. With the exception of the JIC Standards, we believe that we have had considerable savings because of standards, although we can not arrive at a figure in dollars.

"The JIC Standards have increased the cost of our equipment which is an increased cost to the user, but the user benefits because of ease of maintenance and interchangeability of parts between different manufacturers. We believe that a further standardization in the hydraulic equipment group would enable the purchaser of machinery and hydraulic equipment to derive ultimate savings in cost and reduction in service parts."

Another recent (1950) example of JIC standardization is that of mounting dimensions of presses. Seven hundred fifty sizes of presses were reduced to 76; resulting in: (1) lower inventory with fewer sizes and more interchangeability; (2) lower purchase prices resulting from quantity buying on fewer sizes; (3) better workmanship resulting from building "more of the same thing"; (4) easier inspection; and

(5) simplification of service and maintenance. In discussing this case an officer of a well-known automobile manufacturing company said:

CASE 15 "Let me repeat those first two advantages—lower inventory, with fewer sizes and more interchangeability, and lower purchase price through quantity buying. They are the standard advantages of standardization. They operate in almost every field of standardization, from manufacture of safety pins and window sash and electrical appliances to 13,000-ton presses."

The automotive industry benefits by standardization of its tooling of every description—from small tools to the largesst presses—as well as by standardization of the innumerable minor parts built into the product.

CASE 16 An early example of small tool standardization was given by the General Manager of a large automobile manufacturer, who stated that standardization of spindles and guards had made possible the reduction of types and sizes of grinding wheels by 26 percent during the first year, and that it was expected that the reduction would be increased to about 50 percent in the following year.

CASE 17 Another large automobile manufacturer, in a magazine advertisement, stated that about 70 percent of a finished automobile consisted of minor parts, and that standardization of such parts had reduced their variety from 13,000 to 2,000—a reduction of 84 percent. The advertisement continued: "This in turn has reduced the cost of parts to the factories, simplified the service problems of dealers, and benefited the parts makers. And the purchasing economies are passed on to you, the car buyer, in the form of added value."

CASE 18 Still another early example of parts standardization in the automotives field is illustrated by the statement of a national lamp manufacturing company that the standardization of motor car lamp types had resulted in prices being *reduced* 54 percent in the same period during which general living costs had *risen* 60 percent.

CASE 19 While standardization was being applied to parts and tools it was also extended to other types of plant equipment. One factory (a smaller, independent company) saved $8,600 a year by standardizing its conveying equipment.

CASE 20 A comparison of cost per pound (weight) of automobiles, as compared with machine tools, made during the earlier period of standardization showed the cost of inexpensive, highly standardized cars to be from $0.19 to $0.26 per pound while machine tools (and the most expensive cars) averaged about $1 per pound. The great difference in cost was attributed to the extensive standardization of automobile parts.

CASE 21 The tremendous savings resulting from the introduction of standardization and mass production in the American automotive industry are illustrated by the statement, attributed in 1938 to the head of one of the largest companies, to the effect that the automobile then selling for $600, if made by the methods of manufacture available in the early days of the industry (30 years previously), would cost no less than $3,500.

In his reply to a letter requesting data for the present survey one company official wrote:

CASE 22 "The industries where the largest savings are made are those in connection with design and manufacture. For a great many years I was Design Engineer in the automotive industry and had as one of my principal duties the introduction of standardization wherever possible—most of this, of course, was in cooperation with the SAE. The savings evolved were tremendous throughout the organization. In the Engineering Department we used standard parts wherever possible; in the Manufacturing Department they simplified the ordering and stocking of materials and, of course, later simplified repairs.

CASE 23 The replacement of company standards by national or industry standards frequently results in substantial savings. A large automobile manufacturer reported in 1950 that changing from a company standard drill 2½ in. long to a standard 1⅞ in. drill, with a longer holder, resulted in longer tool life and a saving of $3,500 a year.

CASE 24 A well-known case of a similar kind is that of an aircraft manufacturer who saved $268 per plane by substituting industry standards for bolts in the place of special company standards.

CASE 25 In another area of standardization a large automobile manufacturer recently (in 1950) reported that by standardizing 60 shipping cartons for service parts, to take the place of 145 cartons formerly used, a yearly saving of $15,000 was obtained.

Mining and Conveying Machinery

A manufacturer of mining machinery and material handling equipment writes:

CASE 26 "As J—— (Company) has had the Standards Division such a short time, comparatively speaking, there are really not a lot of things that we can actually put our finger on and definitely show what our saving has been. We are sure in our own minds that our savings on drafting formats is about half the previous cost. There are many purchased stock items where certain items have been standardized and many accounts closed. These things cannot show directly just what is saved, but there is no doubt the saving is there."

The following letter is from a manufacturer of mining, conveying, and similar machinery.

CASE 27 "We are now engaged in a company-wide standardization program and are at present coordinating the divergent part numbering and engineering record procedures to a common system. We have already

recognized savings at the plants where this project has been completed, since we have been able to economically shift the manufacturing of parts and complete machine from an overloaded plant to a location where idle facilities were available. However, since we are still in the early stages of this program, we are not yet in a position to present specific figures representing actual savings resulting from standardization projects."

Mechanical Fasteners, Etc.

A large manufacturer of bolts and nuts wrote as follows:

CASE 28 "We have many concrete experiences of where ASA Standards have helped our industry a great deal. Unfortunately, because of the complexity of our business, it is very difficult to say in detail exactly what savings have been made. Also, because of the nature of our business, the savings which undoubtedly cut our manufacturing costs have all been passed on to the customer. It is the users of our products in assembling their units who have really experienced the tremendous savings brought about by ASA Standards.

"I assume the most recent one that we may cite as being of tremendous importance is the ASA B18.9 standard brought out in 1950. While it is rather recent and the full impact of this specification has not yet been felt, it has been of a tremendous advantage.

"B18.2 subcommittees are, at the present time, working on standardization work that is going to have a tremendous effect on our industry and even a greater effect on the people who use our products. Again it is going to be hard to give concrete evidence of the actual amount of saving, but it will certainly be very significant.

"The Screw Thread Standard ASA B1.1 has been another outstanding example of standardization and simplification that has meant a great deal to the threaded fastener producer and consumer.

"We only wish that we had some way of estimating the effects of these standards, but it is so broad and so general and so great that it would be very difficult to do."

CASE 29 Among the early examples of savings resulting from the substitution of industry or national standards for special designs is that of a manufacturer who had been paying from $49.90 to $70 per hundred for 1 in. by 4 in. hexagonal head cap screws. After standardization the same screws could be bought for $9 per hundred.

CASE 30 Standardization of washers by another manufacturer reduced the variety used from 1,350 to 150. Smaller inventory and lower tool replacement costs brought about a saving of $25,000 a year.

Heating and Air Conditioning Equipment

A letter from the secretary of a national association of heating, piping, and air conditioning contractors gives the views of the Association in the following letter:

CASE 31 "This National Association believes that standardization has been a factor in creating economies in this industry that have more than repaid the time and effort expended in the work.

"We have been particularly interested in the dimensional standardization of flanges and fittings which have made these interchangeable so that it has not been necessary to wait in obtaining a fitting of a given make in order to repair a line.

"The old practice where an inspection of the work to be done was necessary, to be followed by the order of specific material and then the wait until that material could be obtained, no longer prevails."

An example of a firm that profits from the use of standards in purchasing and manufacturings, but which produces specialized, nonstandard products, and is opposed to standardization of its products, follows. This firm manufacturers "air handling and power plant machinery."

CASE 32 "We emphasize all possible standardization in our own manufacturing and welcome standardization on the part of our suppliers. However, we are ourselves in the rather unique position of not manufacturing standardized items, and do not welcome standardization in the equipment which we manufacture. In other words, we are not mass producers. Every item which we manufacture has special outstanding features which make our equipment more desirable to our customers than standardized articles to the extent that they willingly pay more money for our 'job produced' equipment.

"We know that our customers profit by standardization—as do we, as. for instance, NEMA standards built into our equipment, but we have no desire to standardize our equipment with equipment performing the same functions as manufactured by others."

Typesetting Machinery

A large manufacturer of typesetting machinery writes:

CASE 33 "So many intangibles are involved that savings can only be 'guesstimated.' Factory costs are reduced, probably, by 1 to 3 percent."

Packaging Equipment

The following letter from a manufacturer of packaging equipment reports benefits derived from the standardization both of parts and of products:

CASE 34 "In particular, we find that standardization of our own products permits us to schedule similar products in sequence so as to reduce or eliminate changeover and set-up time. We find that this increases our plant production by approximately nine percent.

In our engineering of the various tools which we furnish to the field for strapping and packaging we find that we can save both time and money by designing for identical parts disbursed through several models."

Precision Equipment

The following from a large manufacturer of precision equipment, much of which is specially designed, is one of the outstanding contributions covering the entire field of application of standards in the production of intricate apparatus.

CASE 35

"Savings

"Ever since World War I, we have been active in setting up Standard Practices in materials, methods, and procedures. In World War II our Standard Practice books were found to be of great value to the various prime contractors and sub-contractors, who made our products, as well as to the vendors who supplied parts. Without such Standard Practice, interchangeability between products, made by different manufacturers, would have been impossible.

"As the S—— G—— Company has some 60 active products, many of which are specially designed for the Armed Services, and for which we have to meet the various Army, Navy, and Air Force specifications and standards, our standards problem has been a very complicated one. At present, our Standards Department and Standards Laboratory each employ about 50 employees, and constitute about 4 percent of our engineering division personnel. In addition, the Factory Methodizing and Planning Departments have a considerable number of people employed on standards work in connection with manufacturing processes. Although our standards and standard practices might appear complicated to a newcomer, we could not operate a single plant (of 12,000 employees) with such a large variety of products without them.

"While it is impossible to cite exact economic savings in terms of dollars and cents, the savings we are making through our system of standard parts, engineering and design standard practices, standardized raw materials and manufacturing processes, are estimated to be several million dollars annually.

"Procurement

"Standard parts, such as gears, screws, pins, bearings, and electrical components, now account for a major fraction of the components used in current product design. Since these items are used repeatedly, they are stocked and procured in larger quantities with appreciable savings.

"In the materials field, we have reduced 30 different paints to 15, 120 different cutting fluids to 10, 50 different tool steels to 6, and 12 different aluminum casting alloys to 3. Savings in procurement, materials handling, and shop processing have resulted from such variety reductions.

"We have incorporated industry standards, national standards, and some of our own where necessary. This has increased availability of suppliers, particularly in the materials field.

"Engineering

"Our system of standards has not entered into the field of standardizing the end product as such due to the variety of our customers and fields. In fact, many of our products might be termed 'custom built' in that they are designed to meet the specifications and needs of the Armed Services. It has, however, materially reduced the variety of parts, materials, and finishes called for in our product designs.

"We have thoroughly standardized our drawings and drafting room practices. This item alone saves many thousands of manhours yearly within the Company and without, particularly now when subcontracting is so heavy in connection with the expanded rearmament program.

"By using broad general materials standards, purchase specifications, and a number code materials identification system, we can change our standards to meet materials restrictions without changing individual drawings. Similarly, we are using component purchase specifications applicable to many parts so that blanket changes can be made without changing individual drawings. Under emergency conditions, this flexibility is very important and has eliminated the necessity for thousands of costly drawing changes during such periods. The number code material system has greatly facilitated the compilation of CMP data.

"Manufacture

"The factory has fewer different materials to handle and a corresponding reduction in stocking and control records as a direct result of materials standardization.

"Shop operations have been standardized through manufacturing specifications for processing such as electroplating, brazing, spot welding, finishing, etc. Operation sheets refer to these specifications and are greatly simplified as a result. The Shop personnel become thoroughly familiar with these specifications and new employees can be trained with their aid much more rapidly.

"Since we are engaged in interchangeable manufacture, our standards on machine fits are especially important in reducing tooling and gauging costs and in reduction of inspection time.

"Materials quality control operations have been standardized and component inspection and test recommendations have also been standardized. These steps have improved our quality control and have saved inspection time determining what inspections should be made.

"Distribution

"Benefits of our standardization in this area are limited; however, field service on our products has no doubt been made easier and less expensive as a result.

"General

"Reduced inventories of materials, parts, and storage cost have resulted from our material and component standards. However, our procedural practices affecting interdepartmental coordination with Engineering are much the most important benefit in this area. Many thousands of valuable hours of our technical personnel are saved through the use of standardized procedures."

A smaller manufacturer of precision equipment writes as follows:

CASE 36 "It would take considerable research to try to evaluate the net savings where standardization

had been of benefit to us. However, there is no doubt that the standardization of hardware, testing methods, material specifications, and other similar programs has resulted in a considerable saving to our company, and a general decrease in the selling price of most of the apparatus produced by our company."

Quality Control

Analysis of the marked check lists referred to in the section headed "Summary of Results" indicates that about half of those who returned these lists derived savings from improved quality control resulting from the use of standards. It is not easy to determine money savings accruing from this source, but the following quotation from a recent (1950) article by the Director of the Quality Control Department of a large electrical manufacturer gives some preliminary figures.

CASE 37 "The return of a buyers' market has caused prospective purchasers to be more critical of product quality. They are setting their standard for quality much higher than they have been willing to accept in the past, with the result that rejections in the receiving department are becoming more frequent, and the return of materials to suppliers is becoming a serious problem. Naturally, this leads to higher costs both for the purchaser and supplier. There is first the cost of inspection, then, the added cost of handling the materials, plus freight costs for returning them to original sources. Added to this cost is the contingent cost of added clerical work and the disruption of manufacturing schedules.

"These costs have become more important because of rising labor rates all along the line. Furthermore, the supplier is plagued not only with returns from purchasers, but with rejections in his own manufacturing plants. These rejections arise from the product failing to meet whatever standards the inspection organization has set up, or understands to be the yardstick of product quality. In American industry today, it is estimated that this total cost of rejections amounts to something like three billion dollars annually, which is more than the retail value of all electrical household appliances, including radios and television receivers. This cost of rejections may amount to as much as 3 percent of total manufacturing costs. Preliminary studies now under way indicate that when costs of rejections do not exceed one-half of one percent of total manufacturing costs, they may be considered to be normal. Therefore, it appears that manufacturing costs can be lowered by as much as 2½ percent by keeping rejections to a reasonable figure."

In another case, recently reported by the National Association of Purchasing Agents, it was said that—

CASE 38 "The method is primarily adapted for the use of manufacturers, but there is increasing cooperation between manufacturers and their customer industries in the use of the method. It was through the use of this system that A—— S—— Company discovered a $60,000 yearly loss because the yarn supplied was overweight."

Electrical Industry

The importance of manufacturers' standards in the electrical manufacturing industry, and their effects on production costs, are well illustrated by the following quotation from a *paper* (June 1949) by the officer in charge of engineering and research of a large company.

CASE 39 "Both classes of standards (i.e., manufacturers' standards and industry standards) are important, and because of their money-saving qualities they merit your firm support. For example, consider the seemingly insignificant matter of the drain plug in a circuit breaker. 'How,' you say, 'can a ten-cent plug have any real effect on the true cost of a $10,000 product?' Take the actual case of the drain plug on the tank of a 50,000 kva circuit breaker. In order to meet customer demands, we may have to provide a ½, ¾, or 1-in. drain plug or drain valve, a special sampling valve or a special oil gage. In the past 15 weeks we have been required to manufacture this particular tank in eight different combinations of details. Under modern manufacturing methods we cannot use the 'handmade' method of having someone take a new plug of different size—which we probably do not even stock—down to the shop and say to Joe, the workman, 'Put this odd size plug there instead of where the drawings call for it.' Manufacturing setups established to capitalize on volume require more formality. This detail change has to be handled through the order routine, and costs about as much as handling a new order. Drawings have to be changed, the new material purchased and, with appropriate instructions all in writing, Joe can then screw in the new plug. Cumbersome? Yes. But short-cut it and you get confusion.

"The cost of this minor change may well total $100 to $200. 'But,' you say, 'such a charge is exorbitant,' —and besides you have never been asked to pay it. True. But it is there just the same and must be made up in the overall, aggregate cost level of the apparatus. A charge of this magnitude is seldom made directly. Perhaps it should be. It would make the economic loss of seemingly trifling deviations from standard more apparent. But accounting systems are not set up to do this—and if they were, that variation from standard would increase the cost even further."

CASE 40 The same manufacturer reported some years earlier that the saving from the standardization of "expense materials," such as abrasives, brake linings, etc, during the first year of standardizing work was $15,000, and that it had subsequently reached approximately $50,000 a year.

A smaller manufacturer of electrical machinery emphasizes the necessity of having established standards both for production and for servicing its products:

CASE 41 "In our business it is necessary not only to maintain stock

of essential parts at our plants but it is also necessary to maintain a stock of these parts in our various service stations and at our distributors.

"The W—— Electric Corporation has for years recognized the desirability of using standard materials and parts. Without the use of these established standards it would be difficult, if not impossible, to maintain an inventory for standard production, and, of still greater importance, for service parts.

"One of our established rules is that in every possible instance when the part is changed for a standard production design the revised design must be interchangeable with the parts which are superseded.

"In other words, we believe thoroughly in standardization and have been making use of the advantages of standardization for a great many years."

Another manufacturer of electrical and mechanical apparatus writes:

CASE 42 "Our business is Industrial Electrical Control, and to pursue this business successfully it is necessary that we have about 70,000 different items of stock. At the present time we are placing a new starter line on the market which has been redesigned with the idea of maximum standardization of parts, materials, and inventory, with mechanization of assembly. This program will benefit us greatly in the near future.

"We have on our cost and inventory records approximately 7,000 different styles of cabinets. We are planning to standardize these different cabinets into several dozen different styles and sizes, thereby being able to cut unit costs and quantities and eliminate wasted material to a marked degree.

"By and large, it is impossible to do too much standardization with the older line of products until they have gone through redesign. We have set up a program of redesign through which we hope to achieve the economies that we have been able to achieve on our line of starters."

Still another electrical equipment manufacturer states:

CASE 43 "You have listed many ways in which savings result from standardization. Actually we do not consider these points as savings, rather as a necessity for successful and progressive company operation."

A manufacturer of carbon brushes for electric motors and generators gives its experience:

CASE 44 "Many standards have been made for the carbon brush industry. These have resulted in great savings to members of the industry in the following ways:

1. Procurement of copper cable, lugs, and clips. Larger quantities can be purchased because of reduced number of standard sizes.
2. Some simplification in manufacturing is expected in the near future with the adoption of a joint AISE and AIEE Standard on Mill Motor Brushes.
3. Elimination of disputes concerning tolerances since standard tolerances have been adopted by the industry.
4. Allowance for overage and underage in shipments to the extent of 10 percent.
5. Somewhat reduced inventories of material.

"All of the above have resulted in considerable savings but since many of these standards have been in existence for a long time, it would be impossible to evaluate the actual dollar saving.

"There is still room in our industry for considerably more standardization and with the cooperation of motor and generator designers, this would result in large savings to the user. Steps are being taken to make these changes."

An official of a large automotive manufacturer, in a paper published in 1950, described the substitution of an industry standard for individual company standards for motor brushes:

CASE 45 "Another example of economies made possible by the use of industry standards versus company standards is carbon and graphite brushes for use on electrical motors. Company standards list varying lengths of brushes, bevels ranging from 10 to 30 degrees, shunt lengths from 4 to 7 in. Grade classification runs in six specifications. By the simple use of predetermined standards recently established by the brush manufacturers working in conjunction with the motor industry, one brush of average length with shunt of 6 in., and an average bevel between the high and low point, and using a good quality grade classification would replace these multiple types. By this standardization in the industry, the brush manufacturer can produce the requirements needed by customers on a yearly basis about 25 percent cheaper than previously. Deliveries are made promptly from stock whereas, in the past, four to six weeks was common practice. Such standardization has already shown results in the railroad industry. Formerly, the railroads carried approximately 900 types of brushes in inventory, but with this standardization the number of types has been cut to 323. The D—— E—— Company has reduced its stock inventory from 485 types of brushes to slightly over 100 types. At the present time studies are being made in our company to utilize the brush standardization idea in our plants. From conservative estimates, this will save in the neighborhood of $25,000 to $30,000 a year."

A manufacturer of insulators, ceramics, and line hardware writes—

CASE 46 "There is no doubt in my mind that the American Standards Association is performing a very valuable function to the industry, and that the savings which we, as a company, have achieved through standardization are great. In fact, almost every phase of every industrial operation is today vitally influenced by the results of standardization, and by the activities of the American Standards Association. Not only are these effects felt as a result of those standards applying directly to our business, but perhaps even greater effects are realized unconsciously

through the influence of standardization on the raw materials and component parts which we regularly use and think little of. Screw thread standards are an excellent example of the influence of standardization on all industries. It is almost impossible to express the value of such standards in dollars.

"Prior to the preparation of ASA Standard C29.1-1944, 'Insulator Tests,' there was wide variation in the test methods in the industry, and equally wide variation in the test results obtained. This led to disagreements, special test set-ups of many types, delays, and inevitably increased costs. There can be no doubt that we, as a company, our industry as whole, and our customers have all benefited from the existence of ASA Standard C29.1. The same might be said of other standards influencing our business. We cannot, however, assign a definite number of dollars and cents to these savings."

The Executive Secretary of a national society of motion picture and television engineers has the following to say:

CASE 47 "Standards are really the life blood of motion pictures, for without them there would be no motion picture industry."

The Associate Director of the engineering department of an association of radio and television manufacturers expresses the views of his Association:

CASE 48 "In reviewing your check list it occurs to me that our industry has a greater interest in interchangeability over a much larger area of engineering than is indicated by the list. Interchangeability of tubes and many other components is a matter of utmost importance in design, manufacture, and use (servicing). Interchangeability permits the use of multiple sources of supply in design and manufacture, making savings possible by avoiding changing construction if a change of source of components is necessary. The user of the equipment is benefited by being able to more readily and cheaply obtain service where interchangeability exists. Obviously, without the fairly high degree of electrical and mechanical standardization in the tube field the problem of servicing radio and television receivers would be unthinkably worse than at present."

A manufacturer of electronic devices, while unable to evaluate savings in figures, describes the utility of standards:

CASE 49 "We do make use of standards of certain types such as the following:

Vacuum Tubes	Screws
Resistors	Audiometers
Capacitors	Nomenclature

"We feel that the standardization of many of these items has been a great help because we know what is available and we design our instruments in accordance with these standard parts.

"However, it does not seem possible to express the value of this standardization in figures. We do realize that it is helpful in design work to know what items will be available, and in the case of vacuum tubes, what performance characters may be expected."

Electric Utilities

There are many examples of savings derived from the use of standards by companies engaged in the distribution of electrical energy.

CASE 50 A large system serving an eastern city reported twenty years ago that a saving estimated at $750,000 a year was brought about by standardization that reduced the number of sizes and types of cable used from 500 to 134.

CASE 51 At about the same time an electric utility serving another large eastern city enumerated the following reductions in cost due to standardization:

1. Standardization of a-c recording watt meters reduced the cost from $11 to $9, making a total saving of $3,000,000 on an annual production of 1,500 meters.
2. Standardization of transformer ratings resulted in limiting the increased cost of transformers to 7 percent during a period when general prices rose 60 percent.
3. Standardization of the common ¼ h-p appliance motor reduced its price from $25 to $9.50, a reduction of 62 percent.

CASE 52 Many savings have been accomplished by an electrical power company, located in a central area, which has carried out an extensive program of standardization over a considerable period of time. Among these are:

1. Development of a standard specification for trolley cord instead of purchasing on a trade-name basis, saving $1,000 a year (40 percent of cost).
2. The use of standard specifications and centralized purchasing, eliminating "private stocks" which in one department alone were estimated to have a value of $100,000.
3. Standardization studies resulted in the development of a wheel for cutting fire brick which produced a net saving of $3,000 a year.
4. The Vice-President in Charge of Purchases reported that there were "numerous other instances of saving from $5,000 to $40,000 a year directly resulting from this (standardization) work."

A large public utility operating in a thickly populated eastern state submitted the following statement regarding the utility of standards in its electric operation.

CASE 53 "The obvious savings resulting from standardization, both within a single company having numerous operating divisions and throughout the electric utility industry are those of material; usually critical material in times of emergency. There are further savings in manpower in terms of man hours to manufacturer, to engineer, and to install, and of cost in the form of reduced expense of manufacture, of application enigneering, and of installation. No detailed comment on the saving of critical material and of manpower is needed at this time.

The saving in cost of electric facilities is one of the major items which has permitted the electrical utility industry to maintain over a long period of time its unique position of reducing the cost of its product to its customers.

"The standardization effort of this Company has been expressed in two forms: 1. the selection of certain units of various manufacturers' products for universal application throughout the property. 2. The participation through technical committees of national organizations in an active campaign to make the product of different manufacturers interchangeable and to decrease the number of types and sizes of equipment to be produced. These procedures are especially important in substation and in outside plant of all voltages since it is in these fields that large numbers of identical or interchangeable units are purchased and installed. Thermal generating stations require a great amount of special engineering and, in general, utilize small numbers of major items of equipment where repetitive manufacturing methods are impractical.

"It is extremely difficult, if not impossible, to establish the exact saving resulting from an individual case of standardization because of the general inflationary trend of prices over the past years during which standardization has been most active. For example, single phase overhead distribution transformers have been completely standardized as to mounting dimensions and the number of sizes cataloged has been reduced from 23 to 12 by cooperation between manufacturers and users. During the same period the price of an individual transformer has advanced by approximately 75 percent. It is impossible for a user to estimate what the price rise would have been had the original number of sizes been retained in production.

"It is the established policy of this Company to avoid special apparatus or equipment wherever practical and to purchase standard items under nationally accepted specifications. This policy operates not only for substations, transmission, and distribution both overhead and underground and meter equipment, but also for vehicles, tools, and miscellaneous supplies. For other classifications of projects requiring special engineering the policy is applied to those portions of the project where repetitive manufacture is possible.

"We feel that it would be impossible to carry out the extensive expansion program necessitated by our rapid growth in load, utilizing the available manpower, if our program of standardization of design, of methods, and of materials had not been in effect."

A specific example of savings from standardization of substations by another company follows:

CASE 54 A steel substation structure had consisted of 154 different kinds of pieces, made of innumerable angles, channels, and plates. The redesign resulted in a stronger and more flexible substation which consisted of only 9 different pieces made of 2 sizes of channels, 2 sizes of angles, and 1 gusset plate.

The best price previously obtained on the old design was about 18 cents per pound galvanized. The cost of material for the new design was less than one-quarter of the cost of the old, and over 50 percent was saved on the cost of erection. A large number of drawings was reduced to a single sheet containing both shop details and the erection plans.

The following is from a public utility supplying both gas and electricity to a large city in a northeastern state:

CASE 55 "The gas industry since the middle '20s has very effectively used standardization primarily to promote safety in the use of gas burning appliances, but the effects of standardization have gone much further to assure purchasers of such equipment a reasonable minimum in performance, efficiency, and quality of product.

"Similarly, the electrical industry over many years has been thoroughly sold on the value of standardization. It is hard to visualize how we would get along without standardization of such items as voltages, fuses, lamps, motors, transformers, etc.

"The economic saving not only to industry in being able to produce lower cost products, to manufacturers and distributors in the volume of parts and materials required for stocking, but also to consumers, must be of tremendous magnitude."

A specific statement of dollar savings from transformer standardization is contained in the following from a medium-sized public utility in a central state:

CASE 56 "For some years we had been purchasing 7980-volt distribution transformers on special specifications which were augmented by E—— B—— Company. The 'specials' had to do with polarity, voltage ratio, and number of mounting positions. In 1948, due to co-ordination work by the AWA working through the Edison Electric Institute and National Electrical Manufacturers Association, the national standards were established sufficiently close to our special specifications that we could use them. This resulted in a saving of 6 percent on the cost of each transformer. We estimate this saving to be $25,000 on our 1951 purchases alone."

Savings due to the use of national or industry standards are indicated by the following from a light and power company operating in a central state:

CASE 57 "Since the formation of the Engineering Department two years ago, we have been doing everything possible toward adopting and utilizing national standards for the purchase of our equipment."

Excerpts from resume attached, reporting on results from a number of standards adopted:

"Meter Test Blocks. August 1, 1950 we standardized on 5 items. On purchases made since that date, our saving has amounted to $3,280.

"EEI-NEMA Specification TDJ-19 1949 for Mounting Brackets. By

adopting this specification, lightning arrester manufacturers at last made it possible to replace a damaged arrester by a new arrester of another make, without labor cost of replacing bracket."

The following from a power and light company operating in a north central state describes its thoroughgoing adoption of standards.

CASE 58 "Our company attempts to standardize not only items of material and equipment, but procedures and policies as well. Therefore, we have many policies which are standards in our company. The greatest part of our procedures for conducting our business also are standards adopted after many years of experience.

"Almost all the materials we use in the construction of our transmission and distribution lines, also our substations, are standardized materials; that is, they are listed by us as Company standards. The majority of these items are so listed that they are similar and serve the same purpose and are of equal quality, so our Purchasing Department may purchase them from any one of a number of manufacturers or vendors. This is also partly true of some of the equipment we buy. On the other hand, where a certain manufacturer's apparatus is better adapted to our need, that one manufacturer's particular item is standardized by us for our use.

"We also have standard sizes of drawings and blueprints, and all sorts of so-called standard drawings such as connection diagrams for meters, relays, gas connections, water connections, transmission and distribution line construction. In fact, we have several hundred of these prints reduced in size and put into a looseleaf pocketsize book for our construction people.

"We have a committee in our company known as the Standardization Committee which deals with the standardization of all sorts of items used in our business. I suppose we could operate without any standardization. In fact, we did so in the earlier days, but it was costly, inefficient, and confusing, so one of the first things we did in this organization was to set up a standardization procedure.

"There can be no question that the reason America has made such tremendous progress in all things is largely due to the standardization of products, sizes, threads, dimensions for various devices. The savings to the ultimate user throughout the nation is beyond comprehension."

Another public utility company in a north central state gives the following description of savings due to the standardization of distribution transformers.

CASE 59 The effort of the EEI-NEMA Joint Committee which results in distribution transformer standards that now are embodied in ASA Standard C57 clearly made a contribution which resulted in economic gain for everyone concerned. The records of price movements in this equipment as compared to those for large power transformers (which inherently are not so susceptible to standardization) clearly indicate that the advent of standards in distribution transformers brought economies in manufacturing which materially have restrained costs—and, hence, prices. Since C—— P— Company has purchased in the last six years distribution transformers valued at almost six million dollars and expects to spend one to two million dollars on them this year, you can see that we value a development which has effected a saving for us running into substantial figures.

The following is from a gas and electric company, located in a southern state:

CASE 60 "We feel that savings have resulted from the purchase of apparatus manufactured to industry and ASA specifications, and from the specifications of other standardization groups such as the ASTM and the national engineering societies. We also have benefited in our engineering activities by the availability of accepted standard specifications, and we have employed standards for drawings and drafting room practices.

"Use of company-developed standard construction methods has resulted in savings due to simplification in the preparation and issuance of construction projects.

"We are also convinced that approval standards, such as the ASME Boiler Code and the various approval requirements for appliances, have contributed greatly to safety and satisfaction in the supply and use of electricity and in the utilization of gas."

Another gas and electric company in the same area writes:

CASE 61 "There is no doubt that standardization in the electric utility business is responsible for many of the fine economies which we now enjoy. Also, it has made it possible for us to have more strict construction standards which results in carrying a minimum of different kinds and types of materials in our storerooms."

A public utility company operating in a mountain state writes:

CASE 62 "Within our own organization we have striven for a number of years to obtain standardization in our engineering designs so as to obtain the most economic construction possible. We have also cooperated with the manufacturers of the equipment which we use in developing standard designs for the industry and we are making use of the standardized equipment wherever possible.

"Since the end of World War II the general construction cost index has risen a very large amount and it is only because of standardization that the cost of numerous items of electrical equipment which we purchase has not risen as high a percentage as the general construction cost index."

An early (1931) example of substantial savings by a public utility operating company from the stand-

ardization of printed forms is the following:

CASE 63 It was stated that the standardization program had resulted in actual savings of $1,270,000. in four years. Taking consumers' bills as an example—

Yearly cost before standardization	$22,531
Yearly cost after standardization	9,068
Yearly saving	$13,463 (60%)

On 40 different forms the savings ran from 10 percent to 89 percent of the cost per 1,000.

Electrical Communications

A company operating electrical communications equipment (and also manufacturing it to a limited extent) writes:

CASE 64 "We have striven constantly to effect standardization in all operations throughout our entire organization. We know that the results have been tremendously important from the standpoint of savings of physical resources, manpower, time, and money but it is not possible for us to evaluate these savings.

"We have established in our engineering department a Standardization Section. Small examples of the results are a reduction from 76 to 5 basic metal cabinets; these 5 standard cabinets, with appropriate modification, providing 141 ultimate types. A former total of 66 basic types of relays has been reduced to 18, through this standardization work.

"Standardization is also an important part of the work of the Production Methods Section in our small manufacturing operation."

The following from a large telecommunications system stresses the savings resulting from the standardization of piece parts of apparatus:

CASE 65 "The economic benefits of standardization to W—— U—— may be classified as:

1. Direct — Those resulting from Company-instituted standards and from the adoption within the organization of standards set up externally on a national or international scope.
2. Indirect — Association, industry, and American Standards adopted by the manufacturers who produce the materials and equipment utilized by W—— U——.

"W—— U—— uses printing telegraph and facsimile machines in fairly large quantities and one of our standardization policies has been the interchangeability of piece parts, wherever possible, among the various types of similar machines. New designs utilize existing piece parts unless economically or functionally undesirable. This policy effects economies in:

1. Engineering — Eliminates design and testing of new parts.
2. Procurement — Larger quantities —Use of existing manufacturing tools.
3. Warehousing — Fewer items.
4. Reduction in field maintenance stocks.
5. Reduced training of maintenance personnel.

"A concrete example of direct savings resulting from Company piece part standardization is a recently developed machine known as 'Desk-Fax,' a small compact sending and receiving facsimile machine suitable for use in any business office or on any executive's desk. The Desk-Fax was originally designed for use in a patron's office to transmit telegrams to, and to receive telegrams from, a W—— U—— central office. This machine was not released for production, however, until its design comprehended the requirements of a similar machine for patron-leased services. The design engineering and the production of the latter machines have been expedited considerably by the utilization of the basic features of the original machine. The warehousing of piece parts and field maintenance of the machines will be more economical. It is expected that the savings in procurement and maintenance of the 'leased' machines may be in the order of 20 percent, because of the extensive use of common piece parts and subassemblies in the two types of machines.

"Evaluation of W—— U——'s direct savings, due to adoption of existing published standards and indirect savings due to standards adopted by the suppliers of W—— U—— materials, is somewhat more difficult because of the numerous factors involved. A definite and continuous saving in engineering is gained by basing physical and chemical requirements for materials on existing standard specifications such as ASTM, SAE, and Government specifications. Also, requirements for some types of circuit components are based largely on RTMA Standards. An important advantage in using these specifications and standards as references is the fact that they are periodically revised to include newly developed techniques and test procedures."

Another large telecommunications system has for many years reported large savings resulting from research and standardization. The following are examples:

CASE 66 A saving estimated at $50,000 a year is now derived from the use of a national standard for wood poles, considering only the case of poles used jointly with other utilities.

Substantial savings have been derived from research and standardization of building supplies bought by the companies, such as: (1) a saving of 61 percent on a $70,000 item by substituting material bought for $0.59 per gallon in place of that costing $1.50 per gallon; (2) another article costing $0.41 per gallon was substituted for one formerly costing $3.04 a gallon.

Standardization of black lead pencils brought about a saving of one-third, or approximately $50,000 a year.

Standardization of paper used in telephone directories resulted in a saving of about $800,000 a year.

Gas Utilities

Examples of savings by public util-

ity companies supplying both gas and electricity have been given above. The two following cases refer to utilities supplying gas alone.

A company supplying natural gas in a southern state writes:

CASE 67 "We, of course, use many standards in the pursuit of our business. Our piping and pressure vessels are well designed in accordance with standard codes. We use standard drafting room practices and symbols. Valves of different manufacture are made to standard dimensions so that they may be interchanged without piping revisions. The attempt to determine the net economic savings due to standardization would appear to me to be extremely difficult as applied to the L—— S—— Gas Company System."

A west coast gas utility writes, as follows:

CASE 68 "Our Company has been growing rapidly and in most cases the benefits we have derived from standardization have been indicated by the fact that we have been able to absorb growth without a corresponding increase in staff. Our situation is in contrast to the typical factory where through the cost accounting system it can be shown that certain standardization has been responsible for producing additional units at a reduced cost."

Railroads

The following from a large western railroad enumerates savings derived from purchasing under standards:

CASE 69 "There are numerous instances where we have adopted nationally recognized specifications in the purchase of materials in order to avoid the payment of premiums or extra charges for special materials. This is true, for example, in steel products, where we have avoided payment of extras by purchase of materials to recognized material standards. By avoiding such premium payments for special requirements, we, of course, realize a substantial economic benefit.

"Similarly, in the purchase of welding rods and electrodes, we formerly stocked numerous brand name items which were purchased as required by our maintenance forces. This resulted in a large stock of miscellaneous material which complicated the inventory. We have subsequently standardized on welding rods and electrodes by adopting national specifications wherever possible and consolidating them into our Specification S.P. 105-T. This classification system has resulted in simplification of stock and benefit in procurement because of larger quantities of fewer items and broader competition among suppliers. Here again, standardization has resulted in substanial savings.

"In our purchases of grinding wheels, we have adopted American Standards Association's identification system and have incorporated these standard listings into a grinding wheel schedule to facilitate purchase and standardized use of the various items.

"Another example of application of standardization has been in our color drift control system for paints and enamels. Because of the large number of colors used on rolling stock and structures, we had difficulty in obtaining color standardization, inasmuch as our supplies of paints and enamels are purchased from numerous concerns. We, therefore, adopted a system of color drift control panels to cover each individual material and color scheme. The use of these color drift control panels has enabled us to obtain uniformity in color from each supplier, thereby broadening competition and insuring consistent appearance of equipment and structures. Reference to color drift control panels has also simplified stock and material handling by serving as ready identification for the individual paint or enamel. This type of standardization could be classified as eliminating disputes between supplier and purchaser, simplifying office work, and improving interdepartmental coordination.

"As a further example of advantages of standardization, would point out our adoption of standard cleaning materials. The S—— P—— Company is a large user of industrial cleaners, both for rolling stock and facilities. For many years we purchased brand name cleaners which eliminated competition and resulted in higher purchase costs, as well as confusion in proper use and control of materials. In order to simplify stocks and promote uniform practices we adopted a system of specifications for cleaning materials which we are now using to good advantage. This system entails the use of standard specifications for cleaning material, each identified by an S—— P—— number and name. In addition, each material is furnished in drums painted in a distinctive color for ready identification. This system is outlined in brief on Chart GO-S-5768-A, entitled "Classification and Use Chart for Standard Cleaning Materials." The chart is posted in all stores and at all cleaning facilities, so that all concerned are familiar therewith. The use of S—— P—— numbers and names as well as the distinctive drum colors, has greatly simplified inventories and resulted in better observance of proper application and use of cleaning materials. It has also been beneficial in the procurement of materials by broadening competition among suppliers. By purchasing materials to our specifications, we have been able to reduce the purchase cost of cleaners substantially and estimate that we are saving approximately $200,000 per year in purchase cost as compared to our previous practice of buying by brand name only."

The following is from a large Canadian railway system:

CASE 70 "I am afraid it would be quite impractical, because of the size and widespread nature of our operations, to provide you with information as to our savings from standardization. There is no doubt that enormous economies have been achieved on our railways but the results are so entangled with other factors that any quantitative figures produced would tend to mislead rather than inform. Within our own organization and through cooperation with

others in the railway industry we are continuously striving toward a greater degree of standardization and much has already been accomplished."

A large eastern railroad system reports as follows:

CASE 71 "Our representatives are completely in favor of standardization and continually use not only the ASA standards, but those of the AREA, AAR, ASTM and Wood Preservers Association. We find them to be of great value in our work.

Another eastern railroad writes:

CASE 72 "Our experience can be summed up as follows:

Procurement Advantages
- Purchase of most economical quantities
- Reduced volume of accounts, payments, records, etc.
- Elimination of disputes
- Broader competition among suppliers

Engineering
- Variety reduction and interchangeability
- New designs more readily coordinated with existing designs

Distribution
- Reduced variety of products
- Better delivery

General
- Reduced inventory of materials and parts
- Minimum storage costs
- Simplification of office work

"While the results from the use of standard specifications are quite obvious and have produced economic advantages, the exact net savings are intangible, and due to our having used standardized specifications for many years, no before-or-after costs are available."

A number of sources of savings resulting from the use of standards are enumerated in the following letter from a small eastern railroad company:

CASE 73 "If it were not for the standardization which has evolved through railroad operation for many years past, especially through the instrumentality of the several divisions of the Association of American Railroads and its predecessor, the operation of the American railroads as an integrated transportation system would be impossible.

"For instance, not so many years ago there were 20 different gauges for track. The track gauge has now been standardized at 4 feet 8½ inches except for a comparatively few miles of narrow gauge line. Through research and experimentation rail sections have largely been standardized, and other track appliances such as joints, bolts, tie plates, etc. Railroad air brake systems have likewise been standardized, as well as the contour of couplers.

"These are just a very few of the almost innumerable items of standardization which have contributed to the successful operation of the railroads of this nation."

Another small railway company in one of the central states writes:

CASE 74 "Our purchases are limited to material for building, track and locomotive maintenance, and operation, plus an occasional item of equipment. Material of the nature used by us has been standardized for a number of years and therefore we have not been in position to benefit through any movement along these lines which may have occurred during recent years.

"It is quite possible that manufacturers of various items of equipment, owned by us, have benefited through adoption of standards, and the benefits have no doubt been passed along to us in the form of lower prices and more ready availability of repair parts.

"We can say that if it were not for standards it would be much more difficult and costly to obtain our maintenance materials in the small quantities which we normally require."

A large manufacturer of air brake equipment for railroads writes:

CASE 75 "The major portion of our product is made to very rigid standards. This will be more fully appreciated when we point out that repair details for freight brake equipment will fit any equipment on the 2,000,000 cars now in operation in this country. The parts that go to make up a brake equipment can be divided into two general categories: parts designed and manufactured by us that have no other application but to air brakes; and purchased parts such as fastening details, bar stock of various metals, and miscellaneous raw materials bought to specification. The materials in the second category are the ones that seem to benefit from the application of the standards principles. It is for this reason that we have supported the American Standards Association. In other words, knowing that we can purchase materials to known standards is very beneficial in our designing work."

Standardization of forms and stationary by railroads has resulted in very substantial savings. An early report by the Chairman of the Stationery and Printing Committee of the Association of American Railroads stated that:

CASE 76 "Through the standardization of forms, as well as of other stationary items, one member line reduced its stationery and printing expense $130,612, or 22 percent, last year (1931), after having made a reduction of $150,650, or 20.6 percent, the previous year. This is a total saving of $281,262 for the two-year period."

CASE 77 A Canadian railroad reported that a program of standardization, accompanied by standard methods of cost control, resulted in a reduction of about 25 percent in a total of approximately 10,000 forms. A "scientific approach" to the problem of manufacturing costs brought about an average saving in cost of more than one-third on about 5,000 of the 7,500 forms retained.

CASE 78 The need of adequate cost records to show the savings due to standardization and simplification has long been recognized by railroads. A report of the Simplification and Standardization Committee, Purchase and Stores Section, Division of Operation and Maintenance, Association of American Railroads, in 1935 suggested that accounts show:

1. Items of stock eliminated;
2. Total book value of stock;
3. Cubic feet of bin space and square feet of platform space released;
4. Book value of surplus or obsolete material disposed of; and
5. Cubic feet of space released by this disposal.

Building and Construction

There are three principal ways in which savings can be derived from the use of standards, or the improvement of standards, in the building industry: (1) from the use of standardized building elements, such as doors, windows, etc.; (2) from the application of dimensional or "modular" coordination; and (3) from the revision of building codes to permit the use of more economical materials or systems of construction. The application of safety standards for the prevention of accidents is also a source of saving in this as in other industries. Claims of savings from all of these sources have been reported in the technical press, but specific figures are difficult to obtain.

Aside from complete standardization, as represented by prefabricated buildings, savings are being obtained from the use of standardized parts such as roof trusses, steel joists, doors, and windows. Several manufacturers advertise their products as "standard" and mass produced. Others advertise that their products are made to "modular standards." In replying to an inquiry about relative costs one manufacturer of steel products writes:

CASE 79 "From a strictly manufacturing standpoint it is, of course, recognized that the fewest number of types and sizes put through the plant results in the greatest economy in cost of fabrication. It is in the field of actual construction—which we do not directly engage in—that the particular advantages of modular coordination develop.

"In recognition of this very marked trend toward modular design, we are making a point to so detail all of our new items that modular dimensions of window or door openings may be obtained with the greatest possible convenience. For instance, in the new design of our residential door bucks we have used a 2 in. width of frame which, when combined with doors in modular sizes of from 1 ft 8 in. to 3 ft 0 in. widths in 4 in. increments, result in a modular size of the assembled door and frame opening."

An architect who has had considerable experience with dimensional coordination writes:

CASE 80 "Unfortunately we do not have comparative cost figures on modular coordination and the old types of construction.

"We are firm believers in modular coordination, and the relevant standards of building units developed accordingly.

"In all the projects we have had constructed of modular coordination, we have been compelled to employ contractors and sub-contractors inexperienced in modular coordination and, in many instances, the various sub-contractors, also foremen, were unwilling (lack of intelligence) to learn modular coordination. However, we assumed the role of instructor and exercised strict supervision to the extent that upon completion of the projects, modular coordination was being highly complimented and the general belief has been that if correct comparative costs had been listed, the general construction costs would indicate at least a 5 percent reduction from the older type of construction and that if modular coordination with all relevant standards of units were combined, a considerably greater saving would be realized."

In a recently published article on modular coordination it is stated that—

CASE 81 "In Syracuse, New York, the architects for a state housing project wanted proof as to whether the project would cost less if it were modular than it would if it were put together in the old, haphazard way. After the design was settled upon, they drew up two sets of blueprints, one modular and one non-modular. They sent a set of each to every contractor who was to bid on the job and asked for pairs of bids on the project, one if it were modular and one if it were non-modular. Every contractor put in a lower bid on building it by modular Coordination. The successful bidder's price to do it modular was $8,000 less than to do it the old way."

A case in which the cost of research necessary to develop standards for modular doors is reported, as well as the saving derived from the standardization, is recorded in the December 1950 issue of STANDARDIZATION, as follows:

CASE 82 "Approximately 50 percent of the doors used in Sweden are now made according to Swedish Standards. This has resulted in a saving of about 450,000 Swedish kronor ($90,000) per year as compared with the cost of doors before standardization. The cost of the research on which the standard sizes were based was about 50,000 kronor ($10,000)."

An editorial in the May 3, 1951, issue of Engineering News-Record under the title "Modernizing Codes Cuts Building Costs," calls attention to ways in which the revision of building codes has resulted in lower costs. It is said that—

CASE 83 "Improvements have been made steadily in the design of earthquake-resistant buildings in Los Angeles, tending either to lower construction costs or to yield better buildings for the same money. Two factors—probably interrelated—are responsible for these gains: availability of imaginative building design-

ers and existence of an up-to-date, intelligently administered building code.

". . . In these structures, the light-gage steel floor systems were designed to act as diaphragms, to transmit lateral or seismic forces to reinforced concrete shear walls. Carrying only vertical loading, the structural frames thus are lightweight and low-cost.

"These savings in materials and money were made possible by recent changes in the Los Angeles building code. They point up the advantage of having a code that will permit new materials and methods of construction, or that can be revised quickly and with little expense. Moreover, such a code, intelligently administered, stimulates designers to try new schemes that offer possibilities of lowering building costs."

A manufacturer of building materials, although unable to supply quantitative data, writes as follows regarding economies resulting from standardization of raw materials and plant:

CASE 84 "Our Company, of course, has effected many economies through standardization, but they are quite difficult for us to evaluate. For example, our Engineering Department has standardized considerably in the electrical and power equipment at our various plants throughout the country. In addition, when we recently constructed new asphalt tile plants at Kankakee, Illinois and Jackson, Mississippi, we set up the facilities in a manner that could be considered standardizing on a unit plan. Similar steps have been taken in connection with our glass container plants at Millville, New Jersey and Dunkirk, Indiana. Our Purchasing Department, likewise, has accomplished considerable standardization where the same raw materials are used in more than one factory. For example, resins that are used for making asphalt tile flooring are purchased on uniform specifications for all of the four plants manufacturing that product. Certain other materials have been contracted for on a Company-wide basis."

Iron and Steel

An association of iron and steel engineers submitted notes regarding a number of standards, among which are the following:

CASE 85 "D-C Mill Motor Standards. The use of the d-c mill motor has been an important factor in the electrification of the steel industry. As a result of their adoption it has been easy for steel plants to carry spares which are always available as substitutes when break-downs occur. This standardization resulted in interchangeability of mounting dimensions for the motors made by the various manufacturers. In addition, the design features were pointed towards steel mill usage, giving a more dependable motor and also one which is designed for fast repairs in case of break-down."

CASE 86 "Standards for Machined Surface Finishes. The use of this standard has enabled the design and drafting room to easily specify machining practices in the shop. Inasmuch as the cost ratio of a very fine finish compared with a coarse finish is as high as 40 to 1, marked economies can be effected by specifying a finish which is no better than that which is actually required."

A large manufacturer of steel tubing lists some of the specific results of standardization which it feels have been particularly worthwhile.

CASE 87 "We feel that the work done by the American Standards Association has resulted in many accomplishments which have been of great value in our field, both to producers and consumers. We are listing below some specific results which we feel have been particularly worth while:

Reduction in number of specifications

(a) Oil refinery seamless steel still tubes
Reduction from approximately 48 specifications to 3

(b) Power piping
After publication this fall, 3 specifications will cover all requirements

(c) Oil production and line pipe
All requirements covered by 3 specifications—5A, 5L, 5LX

(d) Conduit
Recently covered in 3 specifications

(e) Piling
Covered by 1 specification

(f) Low temperature field
Two specifications only—1 for pipe and 1 for tubes

Reduction in number of sizes and walls, etc

(a) Round seamless cold finished carbon steel mechanical tubing—sizes for warehouse stocks
Approximately 2,500 combinations of outside diameter and wall thicknesses reduced to approximately 500

(b) Casing, tubing, drive pipe, drill pipe, etc
Over a period of years, substantial reduction in number of combinations of sizes and walls

(c) Stainless pipe—Schedule 10-S—⅛ in. to 12 in.
Number of wall thicknesses reduced to 18

(d) Standard and extra strong walls—14 in. to 24 in.
Reduction to 1 wall for each size for each class, or a total of 10

Production of semi-finished products

(a) The adoption by ASTM of the recognized AISI permissible tolerances for check analyses, over and above the ladle requirements, and the slight increase in the maximum permitted for certain elements, will serve to reduce the number of open hearth heat rejections and thus show a material savings for both producer and consumer.

(b) The cooperation of consumers in the adoption of new grades of material, such as the special bessemer steel for seamless pipe, has permitted the production of a large tonnage of tubular products that otherwise would not have been available during the shortage of steel products."

A large manufacturer of steel wire writes:

CASE 88 "Standardization in our company has been mainly confined to manufacturing practices so that all of our mills are able to produce any grade of wire for definite application in the same manner and of the same quality and uniformity of properties.

"The object of such standardization is to provide any wire fabricator with material which is satisfactory for its end application regardless of the location of the manufacturing mill.

"Our consumers naturally derive considerable benefit from standardization of this nature while we ourselves have established much goodwill and reputation as a consistent quality wire manufacturer. It is apparent that under these circumstances any monetary value due to standardizing would be exceedingly difficult for us to estimate and it is our thought that the resulting savings might be more readily obtainable from wire fabricators."

The following is from a medium sized manufacturer of steel products:

CASE 89 "We regret that we have no information which will allow us to make an appraisal of the benefits in terms of dollars but we inherently know that they are substantial with us as with all companies employing the principles of standardization."

A large steel fabricator expresses its views:

CASE 90 "Standardization in the steel fabricating business has made great strides in the past half century. However, we can only speak in generalities on this subject for we cannot determine the economic net savings involved. The American Institute of Steel Construction has, for example, issued standard specifications which, when followed, permit a more economical structure to be erected than would otherwise be possible. Likewise, the American Society of Testing Materials has, over the years, developed specifications for steel for practically every purpose.

"For years our company has standardized its drawing practices and more recently this information has been made available to the entire structural steel fabricating industry through the American Institute of Steel Construction."

A producer of pig iron writes:

CASE 91 "There can be no question concerning the very important part this matter has played in the development of industrial economies, and its paramount importance in achieving increased production during the present period.

"Due to the nature of our business we have a very limited need for the many standards so generally used by many other types of industry. To a large degree, we follow the standards that are commonly used in our industry. Also, we have established our own company standards of procedure, in many ways, at our operations in the various localities in which we have operations, over a period of many years. However, we find it most difficult to accurately evaluate the direct savings and at best would only be a very rough estimate."

Nonferrous Metals

The field of nonferrous metals does not seem to offer much scope for demonstrating the savings that result from standardization. The views of two such producers are given:

CASE 92 "The products of our Company largely consist of mill materials, the principal constituents of which are copper and zinc. These two, with smaller quantities of other metals, account for a large percentage of our purchases and likewise of our sales dollar. Such metals are always supplied to standard specifications. Our products are really semi-finished materials and our customers fabricate the finished articles and parts entering into end products.

"I therefore believe that we are not in position to contribute much to your study on the savings resulting from standardization. At least it appears that we are not in the same class with an industry manufacturing a great variety of articles and with an extremely wide distribution of end products. We of course do pay attention to personnel training, packaging and materials handling, simplified servicing, simplification of office work, and other items of the list. Certainly our inventories are much reduced, but to express such saving in terms of dollars or percentages for any period would be difficult."

CASE 93 "We are so little concerned with standardization in our own operations that it has no great bearing upon our functioning. This is of course just the nature of our business. On the other hand, we are very much interested in the standardization of the ultimate products into which our products find their way, and it is for that reason that we have kept close to the activities of ASTM and to some of the activities of ASA."

Chemical Products

A large manufacturer of chemical products submits the following excellent analysis of its use of standards and the savings resulting therefrom. (Precise identification of the types of standards concerned has been omitted, by request.)

CASE 94 "We designate all standards developed by (company name) as 'Company' Standards, but such of them as may incorporate American Standards are so identified. We issue four general types of standards, identified as:

1. Type A standards
2. Type B "
3. Type C "
4. Type D "

"The total number of individual standards in our 'books', as of this date, is 2,034. There was a net of 545 new and revised standards issued during 1950.

"These standards are issued to users in 'books' under each category. There are in the hands of plant personnel, construction locations, Engineering Department offices, and Industrial Department offices some 3,869 Standards books of all categories at 123 different plants and

offices.

"Each year we receive reports from these locations indicating the number of standards used and the direct savings resulting therefrom in manhours, materials, and purchase savings only—no indirect nor contingent savings are considered.

"On the above basis our reports for 1950 indicate the following:

Reports received from	103	locations
Standards used by	95	"
Savings reported by	92	"
Annual Savings:		
Type A standards		$ 870,700
Type B "		114,200
Type C "		9,600
Type D "		52,000
Purchase Savings by certain other standards		110,000
1950 Total Direct Savings		$1,156,500"

Petroleum Industry

As will be seen from the material presented below, the petroleum industry has for many years realized savings from the adoption of standards. A large company, with worldwide activities in both production and distribution, writes:

CASE 95 "We do not have such figures available. This is not because standardization savings have not been realized. On the contrary, we are sure they have and no doubt would amount to millions of dollars annually. The difficulty arises because our worldwide operations and the intangible nature of many of the savings make it impossible to compile this information with any degree of accuracy.

"We have long been convinced of the value of standardization. It has been our policy to cooperate with national organizations, such as ASA, ASTM, ASME, API, etc and to actively participate in the preparation of their standardization. We use them in our work to the fullest extent practicable. In addition to the national and international standardization undertaken by organizations such as yours, we, as a company, have carried on extensive standardization programs on engineering design and operating procedures, all of which have been of great value. A material standardization program has been carried out cooperatively by our domestic refineries since 1934. This has resulted in the elimination of approximately 50 percent of the items which were previously carried in storehouse stock by these refineries.

"We feel that if we were to collect the cost savings on a single feature of standardization, while of some magnitude, they would be insignificant in comparison to the total savings which are being made daily."

Another large producer and distributor writes:

CASE 96 "We recognize the value of standardization throughout our entire operation, and are consciously endeavoring to expand its application. Many of the points of savings covered in your check list are verified by our experience. To cite examples of resultant savings in dollars would require estimating which would lend inaccuracy to the figures. This is particularly true when we have only partially obtained our goal to standardize.

"Exchanger tubes are an item stocked in every refinery. The outside diameter, the gauge thickness, the length of tube, and the material vary. By standardizing on a ¾ in. O.D., 14 gauge, 16 ft-0 in. tube of antimonial admiralty, we have eliminated stocking four other gauges previously carried in the same size.

"In our marketing activities we are actively standardizing on product containers and types of products, eliminating, where possible, slow-moving, low-volume items."

The following example of cost saving by standardization is from an article, by an official of a west coast petroleum company, published in October 1950.

CASE 97 "More recently the West Coast petroleum industry cooperated on a smaller item and slashed its cost nearly in half. Everyone, it seems, who had a gasoline delivery truck also had his pet idea of a delivery funnel. We had our own specifications which cost us $20 per unit. The new standardized specifications, agreed to by the industry and the manufacturers, permit funnels to be bought on an 'off-the-shelf' basis at a saving of $9 per unit.

A smaller petroleum refining company reported that its greatest savings from standardization were in purchased mechanical items:

CASE 98 "This Company has certainly benefited by the adoption of standards, but due to the nature of petroleum refining it is impracticable to determine an economic net savings. Therefore it is necessary to omit that type of information on questionnaire. You will realize that this Company is an end user of mechanical items and therefore the greatest savings to it occur in reduced warehouse stock and saving and time lost in performing a specific job."

A large engineering organization engaged in the design and construction of petroleum and chemical plants describes its use of standards:

CASE 99 "The L—— Company is primarily an engineering organization engaged in the design and construction of petroleum and chemical plants. Each such plant is specially designed to perform a special specified service. In other words we produce a custom-built product which cannot be standardized because of the diversity of purposes and conditions pertaining.

"During the engineering, designing, purchasing, and construction stages of each product, company, industry, and association standards are widely used. In so far as possible, procedures and data for engineering are standardized. Integrated parts such as pumps, instruments, motors, etc are standardized to reduce varieties as to size and type and to avail ourselves of parts readily available and within the standards and specifications and codes of customer, associations, and states. In construction, methods of erection are standardized to a degree and our construction equipment is standardized somewhat to reduce varieties and types and

parts therefor which have to be procured or stocked."

An analysis of the savings derived by the petroleum industry through its standardization programs was reported in 1934 by the Executive Vice-President of the American Petroleum Institute. The aggregate savings of over $14,000,000 a year were detailed as follows:

CASE 100

Belting	$ 500,000
Cable tools	500,000
Rigs and derricks	1,000,000
Tubular goods	8,500,000
Rig irons	75,000
Rotary equipment	1,000,000
Wire rope and cordage	900,000
Pumping equipment	1,000,000
Steel tanks for oil storage	650,000
	$14,125,000

Rubber Manufacturing Industry

A large manufacturer of rubber products reports the great savings that have accrued from the application of standards in the several areas of its activities:

CASE 101 "Our Standards people tell us that over the years they have developed some pretty definite criteria by which they can make rather close estimates of the savings accruing from the application of standards in the several areas of our business concerns.

"When this is done, they report, the following interesting figures emerge:

Economies Resulting from Standardization of:

Purchasing	$20,000,000 annually
Engineering	5,000,000 "
Production	25,000,000 "
Distribution	5,000,000 "
General	10,000,000 "
	$65,000,000 annually

"Of course, these are cumulative figures, the result of long-standing efforts to simplify, to reduce, to make uniform, to make interchangeable, to schedule—all aspects, as you know, of the overall job of standardization."

Photographic Industry

A wide variety of savings from the use of standards is reported in the following from a large manufacturer of photographic equipment and supplies:

CASE 102 "It is not an easy matter to assess in terms of dollars the economic savings resulting from the application of standards. In some cases the advantages, of whose existence we can be most sure, are very difficult to price. I have, however, set down a few examples from our experience with standards in the A—— Division that may be of interest to ECA in their dealings abroad.

"By standardizing on one type of motor starting switches, made up of standard parts, our maintenance of over 2200 switches representing some 55 types can be accomplished from a parts inventory costing only $250 instead of several times that amount. Similar savings have been accomplished in the General Engineering Department by the establishment of (*a*) standard materials for building construction, (*b*) standard designations for ball bearings, and (*c*) standard stock lists of engineering supplies for the guidance of designers.

"Labor utilization standards and incentive job rating standards have been of great benefit in maintaining good labor relations, in collective bargaining, and in controlling production costs. A gradual reduction in paid idle time has been accomplished by production supervision following industrial engineering studies of labor utilization standards in nonincentive work areas. In one inspection area, for example, the percent labor utilization was increased from 55 percent to 77 percent within a space of five months by the application of labor utilization standards which demonstrated the ability to handle heavier schedules without hiring more inspectors.

"Our experience with incentive installations indicates that, in general, production is doubled by labor standards with an additional cost for labor of about 20 percent. The application of work measurement standards shows many nonincentive areas to be operating at efficiencies ranging from 50 percent to 75 percent. Installation of an incentive plan based on work measurement standards brings the efficiency to approximately 120 percent.

"The adoption of a company standard for shipping containers was complicated by a reuse problem from branch stock houses and the need to service accounts of all sizes from carload lot wholesalers to parcel post small customers. The first year the plan was in operation, savings amounted to about $9,000, which more than covered the cost of the industrial engineering survey that developed the standards. Subsequent savings are greater because of greater utilization of the standard container program and the increased cost of packaging materials.

"Standards applied to the receiving, warehousing, and withdrawal for use of some $7,000,000 worth of raw materials annually will result, when the plan is in full operation, in

1. 33 percent reduction in warehouse and trucking personnel
2. 49 percent reduction in storage required in production areas
3. 33 percent reduction in warehouse storage area
4. over-all saving of 16 percent in new material handling costs

"Adoption of new standard procedures and equipment in the payroll department have resulted in annual savings, during the past four or five years, of about $20,000 annually.

"In one plant alone, systems modification and the establishment of standards for cost accounting and timekeeping are saving $35,000 yearly.

"Standardization and control of printed forms saves about $12,000 yearly.

"The establishment and maintenance of quality control standards is, of course, the very heart of the manufacturing process, especially in the photographic industry where, for most of the product, destructive testing is the only possible kind. In that

endeavor the American Standards Z1.1 and Z1.2, Guide for Quality Control and Control Chart Method of Analyzing Data, have been of inestimable value."

The following two cases are taken from an article, published in May 1949, describing cost reductions from standardization by another large manufacturer of photographic equipment and materials:

CASE 103 "One of the early efforts at Engineering Standards was in the direction of substituting commercial sizes of machine screws for the specials then in use. The latter were handled the same as other parts and were each recorded on a separate drawing carrying a 'part number.' When standard screws were established, a standard sheet was drawn up in the usual manner—all size screws of one type being put on a single page in the standards book—and each screw given a 'Standard Number' instead of a 'Part Number.' Recently, the last 600 of these screw drawings were retired and replaced by the standards. No effort was made to evaluate this saving but some estimate can be made from the following facts: The annual saving in blueprints alone was $7500; 60 special screws costing upwards of 15 cents each as made on screw machines were replaced by commercial screws costing about 1/3 cent each; and a sizable sum was also saved in the labor previously required to revise the drawings every time a screw was used on a new product."

CASE 104 "This program, like other standards activities, cannot be evaluated on a wholly tangible basis, but its advantages in a large organization are obvious—the saving in drafting and engineering time, the saving in purchasing by buying greater quantities of fewer items, the reduction in stores inventories, the reduction in obsolete items, and the improvement in the quality of the items themselves. Nevertheless, we get an inkling of the size and nature of the aggregate savings through isolated cases where the savings have been evaluated for specific reasons. To quote a few: One plant adopted the Catalog standards on electrical items and applied EK Standard Numbers to their stores stock cards. When the job was finished, the inventory had been cut from $60,000 to $45,000. One plant developed and adopted Stationery Supply Standards and found a $5,000 annual saving in purchasing these items. Janitors' brooms and brushes were standardized at a savings of 20 percent in the cost of the brushes without sacrifice in the quality. Electronic tubes and elements were standardized and stocked, saving about 25 percent in purchase costs when compared with the former method of placing multitudinous orders for these small items.

"More than half of these standards are applicable to several plants in the company and have therefore been developed on a company-wide scale. Participation in such development, and the use of such standards, is on a cooperative and voluntary basis. The program is a valuable tool in maintaining high quality of materials purchased for all purposes, and assists in the proper application of these materials. The cost of the program is justified by the intangible savings which permeate the entire fiber of the organization, and it can also be justified on a tangible basis by the savings made in purchasing alone."

Textile Industry

A firm of consulting textile engineers points out the difficulty of separating the economies due to standardization from those arising out of other improvements installed at the same time, but contributes the following information on the subject:

CASE 105 "It is somewhat difficult to cover your question treating with economies because of the fact that, in our work, savings are attributed to the development of many different types of economies and in many instances these are not itemized.

"In recent months, we have developed economies, in one instance amounting to in excess of $250,000 per year, resulting from rearrangement of machinery, improvements in operating conditions and specialized machine assignments.

"In another instance we have pointed out potential economies in excess of ½ million dollars per year which can be attained through separating two different types of operations which are currently combined and organizing each on a more practical streamlined basis."

Another firm of management engineers submits the following case in the textile field:

CASE 106 "A recommendation to reduce a particular line from 176 styles to 120 styles has resulted in an over-all increase in plant operating efficiency of roughly 7 percent due to the reduction of end-time required for change-overs, employee training, and machine down time. It also allows the salesmen to do a better and more thorough job of presenting the remaining products, thus obtaining a larger volume of sales in the basic lines and allowing for the economies of longer runs and continuity of operations."

Accident Prevention

Many industries have derived monetary benefits from the use of safety standards for the prevention of accidents. It was estimated (in the report referred to in connection with Case 100) that the petroleum industry had saved over $12,000,000 in 1933 by accident prevention. This was computed in the following manner:

CASE 107 The frequency rate of disabling injuries had declined to 58 percent in the period 1927 to 1933. If the 1927 rate had prevailed in 1933 there would have been 41,910 more injuries than were actually reported in 1933. Since the cost of a disabling injury averaged $300, the total saving on 41,910 cases would be $12,573,000, accomplished by systematic accident prevention (use of safety codes).

CASE 108 In the same year a list was published of five major dust ex-

plosions in grain elevators, with the aggregate losses. These explosions, which it was stated could have been prevented by the use of safety standards, caused:

6 deaths
22 injured persons
Property damage of $1,185,000.

CASE 109 The magnitude of the possible losses that may be avoided by the use of safety standards is illustrated by the estimate of insurance companies in 1937 that 85 percent of occupational diseases are respiratory, and that the court claims then pending, based on silicosis alone, amounted to $500,000,000. The saving to be derived from the use of safety standards in the prevention of silicosis is obvious.

The following four cases are quoted from letters received from accident insurance companies:

CASE 110 "We are informed by our Engineering Department that the benefits derived from the standardization movement are far-reaching, making it impossible for us to itemize or to apply any yardstick under which they can be measured in the form of either dollars or percentages. Perhaps the greatest and most singular advantage in our business has been the standardization of an elevator code presently used by outstanding manufacturers. Likewise, the power press code is of great benefit. There has been considerable benefit in standardization of bakery operation machinery. The work being done on the standardization of ladders is of importance. Numerous other codes and standardizations have benefited insurance carriers and the public, such as highway traffic signals; small home construction; home electrical appliances; and the work done in the wood, rubber, chemical, and fire-resistant materials industry."

CASE 111 "We regret that we are unable to give you specific quantitative statements of savings as requested, inasmuch as we have no way of calculating them beyond saying that our work in accident prevention is greatly simplified, disputes are eliminated, and vast savings not only to us but to our assureds result from our ability to work within a framework of established and accepted standards."

CASE 112 "It is our opinion that in addition to the items included on the check list, the 155 ASA Industrial Safety Standards have greatly contributed to the economy of the country through the conservation of life and property."

CASE 113 "Our engineers fully recognize the value of standardization in manufacturing and production methods, and likewise they are very conscious of the fact that the application of standards in manufacturing operations have a decided influence in the control of accidents. Consequently, even though our general Company operations do not entirely lend themselves to the over-all concept of your letter, we do feel we are contributing in no small way through our Safety Engineering Department, and it shall be our pleasure to continue to lend our fullest support to the purpose of the ASA in every way possible."

An accident prevention association, which serves as a clearing house for safety information, writes:

CASE 114 "We are confident that ASA Standards have resulted in many savings in the field of accident prevention. For instance, standardized guards reduce purchase price and maintenance costs and permit simplified training of employees. The same holds true for personal protective equipment such as goggles, gas masks, protective clothing, etc. Perhaps the most widely used single Standard is that of Z16 on Accident Records. Certainly the use of this standard will give industry a basis from which to gauge their safety progress thereby adding immeasurably to the effectiveness of their accident prevention work. This, in turn, should be reflected in lowered accident costs."

The following letter from the Secretary of an association of compressed gas manufacturers expresses the views of that industry relative to the use of standards:

CASE 115 "Our chief interest is in safety standards. Naturally we are interested in safety in our own members' operations, but we are even more interested in the promulgation of safe practices and standards for adoption by those who use our products. We are happy to have had a part in the development of ASA Z49.1-1950, Safety in Electric and Gas Welding and Cutting Operations.

"Every accident prevented means increased production at lower cost and this is in addition to the human values involved. You will appreciate that I cannot even estimate quantitatively the effect of the ASA, our, and other good safety standards since our products go into every steel mill, shipyard, railroad shop, metal fabricating plant, and many others. I am sure the net effect is very real and very significant and that there are economic benefits of considerable magnitude."

Freight Handling

A firm of management engineers submits the following record of savings due to improvement, including standardization, of a freight-handling installation:

CASE 116 "In one freight-handling installation alone, through the installation of mechanical equipment, the standardization of tasks, and through the development of an incentive program we were able to show a payroll saving of over $1,000,000 a year, or approximately 18 percent of the total payroll."

Maintenance Practices

The same firm of management engineers that reported the preceding case also submitted the following observation:

CASE 117 "Recently in a mill that spends approximately $150,000 a year in their maintenance budget, through the standardization of maintenance practices, the institution of a

sound program of preventive maintenance, and the proper training of personnel and their duties, we were able to reduce the maintenance expenditures against the budget by $37,000 annually. This does not include the consequent savings resulting from fewer machine break-downs, more continuous production, and a reduction of pay to employees for 'down-time'."

Miscellaneous

Standardization of cotton rubber-lined fire hose is reported to have resulted in substantial savings to municipalities. The following report, published in 1941, describes the experience of the Michigan Municipal League:

CASE 118 "Before use of the standard specification the average price of fire hose was $1.25 per ft. Prices based on the standard specification were 48 cents to 60 cents per ft. The League estimated the annual requirements to be 150,000 ft per year. If all hose were purchased on the basis of the standard specification, the saving would be $97,500 per year. Actually, it was estimated that the saving was about $50,000 per year."

The meat packing industry carried out a program of equipment standardization at an early date. The following report refers to work done by the Institute of American Meat Packers:

CASE 119 "A broad program of standardization carried through by this Institute was reported to have resulted in savings of hundreds of thousands of dollars. The design of equipment was improved and standards were established in preference to mere variety reduction and adoption of an existing design. In the case of trolleys, one improved standard design replaced 167 designs which manufacturers had been keeping in stock.

"The experience of the Institute emphasizes the importance of seeking, whenever possible, to improve upon existing designs in a program of standardization, instead of perpetuating one or more existing designs involving perhaps merely traditional rather than rational practices."

CASE 120 The Deputy Commissioner of the Department of Purchases of a large eastern city reported in 1939 that uniform standards of size and quality of printed forms, coupled with reduction in number of forms from 15,000 to 5,000 and sizes from 360 to 170, had brought savings of $200,000 to the city. It was expected that the annual savings would amount to over $300,000 when the program had been in full effect.

Savings from the use of standard specifications in purchasing supplies for public institutions were reported (in 1938), as follows, by an important county of a west coast state:

CASE 121

1. Standardization on 3 designs of china were saved 30 percent on the cost of 10,000 dozens annually.
2. Standardization and variety reduction of pencils to 27 items saved $3,400 (39 percent) a year.
3. Reduction of variety of carbon paper from 100 kinds to 7 saved $3,500 a year.
4. Standardization and contract buying of rubber stamps saved $2,000 annually.

Standardization of packaging has brought about substantial savings in many industries. Case 25 reported a very recent example of this kind in the automotive industry. Earlier examples are reported in publications of a national retail dry goods association, from which the following is taken:

CASE 122 "The standardization of packaging in one case reduced breakage by 17 percent; and in another case freight, delivery, and storage expenses were reduced approximately 10 percent by package standardization. One store set up standard specifications for over 100 items of major importance and over a period of one year brought about savings in packing and stationery supply expense estimated at $250,000.

"Lack of adequate specifications for boxboard cost one store about $3,500 in one year.

"N—— D—— Stores reported that the total savings on folding boxes for the year would be between 20 percent and 25 percent of total costs for the preceding year, based on comparable volume."

The following two cases were reported at a management association conference in 1942:

CASE 123 The Purchasing Agent of a silverware manufacturer estimated that his company had derived a saving of 20 percent from the standardization of packages.

CASE 124 The Purchasing Agent of a cigar manufacturing company stated that the saving of board material from the adoption of a standardized carton amounted to 800 tons per annum, equal to 50 percent.

CASE 125 Standardization of stationery and printing by a small eastern railroad was reported, in 1944, to have reduced the cost from $110,000 to $65,000 a year, a saving of 41 percent.

CASE 126 It is reported by a national association of purchasing agents that in 1944 a large manufacturer of aircraft saved $406,000 by the development and use of standard drawings for hydraulic fittings.

Supplementary Cases

(*see following pages*)

Data received subsequent to the preparation of the preceding cases are presented on the following pages. Cases 127-140 were added to the report after it was organized and prepared for presentation to ECA. Subjects on which savings are reported in these supplementary cases are: Electric Power Generation, Machine Tools, Mechanical Fasteners, Quality Control, Railroads, Chemical Industry, Electrical Industry, Steel Production, and a group of miscellaneous cases which have not been classified.

IV. Supplementary Cases

Electric Power Generation

A report in the June 1951 issue of *Power* describes the economics resulting from the employment of "preferred-standard" units of turbine generators, and the application of other standards in the recent construction of a power generating plant. Excerpts from the report follow:

CASE 127 "Looking over the latest Barbados (plant) units, Nos. 3 and 4, you will find that much of the equipment conforms to standard specifications. This contrasts with the practice in many stations of issuing specifications to meet special requirements. Standardizing lowered the first cost of the plant and let us realize definite time savings which was a major consideration.

"P—— Electric had to expand Barbados when materials were short and deliveries long. Selecting standard equipment helped to ease the pinch and saved money to boot.

"*Turbines.* No. 3 started commercial operation on March 11, 1949, and No. 4 on June 11, 1949. We gained advantage by choosing preferred-standard units, 60,000-kw in this case. These standards were announced in 1945 by a joint committee formed by the AIEE and ASME. Manufacturers immediately offered standard units at a price and time advantage.

"*Boilers.* Unfortunately no boiler standardization parallels that in the turbine field. So we did the next best thing. Advantages of standards come wholly from repetitive manufacture. We discovered a neighboring public utility had bought a steam generator with the same steam and feedwater conditions we wanted. We ordered similar units. In a limited way this was taking advantage of available standards. At the time we ordered, detail drawings had been completed by the builder. These were used for the Barbados boilers, which were built to meet regulations of the ASME Boiler Construction Code and the Commonwealth of Pennsylvania Codes and Regulations.

"*Standards.* Throughout the station we adhered to standards, whether of the national type, such as American Standards Association, Inc, or individual manufacturers' and power company standards. There are an enormous number of standards; ASA has approved about 1124. On analyzing its list and comparing them in detail with utility specifications we found many applications existed. Here are some of them."

(Here follows a long list of standards)

"Standards approved by ASA represent agreements among manufacturers, sellers and users on best industrial practice. These standards, used throughout the Barbados specifications, saved in both time and money by speeding up equipment production.

"Over 1000 drawings were made for this project and these, too, conform to American Standards."

Machine Tools

A large manufacturer of machine tools and abrasives gives the following description of its experience of the economic benefits of standardization:

CASE 128 "Standardization activity in our Machine Division is playing a very important part in our operation.

"Several years ago we set up a standards section. The operation of this section has very definitely contributed to a cost savings, availability of material, flexibility in purchased equipment, and a better control of production as well as delivery.

"This standards section, by cooperation with our Planning Department and Purchasing Department, has contributed in many ways towards better operating and controlled inventory as well as production. By cooperation with the Purchasing Department we have been able to set up better quantities with subsequent price advantages, having been able to establish conversion charts for material ordering on a substitute basis in a limited available market. Most of these have centered around anti-friction bearings, tubing, tube fittings, and similar commercially available items.

"One of our first programs was to standardize and supply such a common item as standard screws. We were able to eliminate a great number of odd sizes and odd length screws.

"Our study on the subject of springs brought out a tremendous advantage. We eliminated the one piece ordering with its consequence of higher cost and long delivery by setting up a standards chart with interchangeability features. The result of this study has been recorded as showing very decided dollar savings.

"We analyzed the savings problem on May 2, 1950 and by compilation of bills and records showed a saving of $6,466 for 1948 and $2,622 for 1949. This came about through transition from special to stock springs through standardization.

"Similarly an analysis of basic raw materials such as various grades of steels set up a reduction of approximately 150 items which reduced paper work and inventory.

"At one time we were using 773 items and cut these back to 604, but then found it necessary to add back a few items, making a net reduction of approximately 150.

"Our standards section is constantly analyzing problems that evaluate the advantages of using commercial available parts as compared with similar parts previously made by the N—— Company. With the problem of material shortages, both in raw form as well as commercially furnished items, we are continuously working to set up conversion charts or substitute lists.

"Our other division, through its Plants Engineer, advises that it is impossible for them to estimate savings

that might be effected by a standardization program because of the fact that they do not experience a regular production schedule in their Factory Service Section. They rarely build more than one machine of a type at any time, and therefore they recognize advantages, yet are unable to determine the degree of economic gain involved. This division does, however, participate in the Standards program of the Machine Division, particularly in regards to ball bearings, screws, springs, and sundry items."

Another large manufacturer writes:

CASE 129 "We operate on a modified lot-repetitive production control system. This method permits the periodic passage of large lots to finish stores. We employ the principles of mass production and interchangeable manufacturing as far as they prove economically sound. Naturally, with small lots, much of our shop time is spent for set-up work, and therefore, less time is available for actual machining. We endeavor in all cases to use the standardization-of-parts principle in order to increase the quantity of the lots in the shop and to reduce the overall number of parts to be fabricated.

"I am enclosing a service manual on our Vertical Turret Lathe line which is in great demand, especially in the aircraft field. These machines are made in a variety of head combinations and are made in the following base machine models: 30 in., 36 in., 42 in., 54 in., 64 in., and 74 in. Please refer to Page 124 in the manual. You will note that Key No. 100 refers to a shaft which has been made standard for all sizes of Cut Master Vertical Boring Mills. Key No. 112 can be used on the 42 in., 54 in., 64 in., and 74 in. models. I believe that this manual is self-explanatory and will demonstrate how we have followed out our practice of standardizing parts for our machines.

"We also make use of industry standards wherever possible, and we have in our plant a manual which we call our Style Book which lists standardization of miscellaneous parts which are used on a wide variety of our products."

Mechanical Fasteners

A large manufacturer of bolts and nuts gives the following description of its use of Standards:

CASE 130 "There is no doubt in my mind that the savings have been enormous through standardization of bolts and nuts, not only in the Bolt and Nut Industry but to the entire country. This is so generally well known and accepted throughout our organization that whenever we receive a request from a customer for an item other than standard, we almost always try to get that customer to accept a standard product.

"In our own purchasing, wherever possible, we try to purchase standard items, avoiding specials as much as we can."

Quality Control

An article describing the economic advantages accruing from the application of standards for statistical quality control in a plant manufacturing hearing aids appeared in the June 1949 issue of *Standardization*. The following is quoted from that article:

CASE 131 "Now let us look at the Hearing Aid plant. The improved uniformity allowed the stocking of a single classification of tube for each type, since it was possible to assemble tubes into the circuit in a random manner and obtain uniform operation. The operation of adjusting and matching the circuit and the tubes was reduced so that half the operators were no longer required on this phase of operations. Some tubes exchanges were required to obtain uniform hearing aids, but the number of such tube changes was reduced to approximately one-tenth of the former value. The number of tubes which had to be rejected after receipt in the hearing aid division was also much smaller and fewer tubes circulated between plants. As a result of the combined effort, we obtained:

Reduced inspection costs for tubes (actually fewer operators).

A reduction in the number of rejects produced and in the cost of tube manufacture.

An improvement in the uniformity of instruments.

A reduction in the number of operators required to assemble and adjust the tube and hearing aid combination.

A reduction in number of tubes circulated back from the hearing aid plant and also lower handling costs.

Due to tube reliability and uniformity of tubes in instruments, a reduction in the number of instruments giving unsatisfactory service."

A firm of management consultants supplied the following example of increased efficiency brought about by quality control:

CASE 132 In a paper manufacturing establishment an increase in "percentage of perfect" from 92 percent to 96 percent was achieved in seven months as a result of the application of quality control standards.

Railroads

The following is from the president of one of the larger eastern railroad systems:

CASE 133 "The railroads fully realize the value of standardization as evidenced by their early attempts in that direction. Some of the earlier steps taken by the railroads were the establishment of standard time, standard gauge of track, etc. This effort of standardization has been carried on steadily, largely through the medium of the Association of American Railroads, until it includes the many items of standards in cars, locomotives, and their appurtenances which make it possible to operate trains over all the railroads in the country without making any alterations in the interchange equipment whatsoever.

"It is doubtful if any industry has realized for so long a period of time the importance of industrial stand-

ardization. It is difficult, however, to give concrete figures as to the value of this standardization because there are so many railroad standards of such far-reaching importance that they have become almost fundamental to the railroad industry itself. Certainly if it had not been for this extensive standardization by American railroads, the public would not know railroad transportation as it is today. In fact, they take the fruits of this economical and efficient transportation so much for granted that they find fault with rare minor discrepancies in schedules which would hardly receive a comment from them in any other form of transportation."

The vice-president of another large eastern railroad writes:

CASE 134 "With its far-flung activities involving so many fields of engineering endeavors, I would presume that there are few industries more convinced of the value of standardization than our own. Yet, I suspect that there are few industries where the directly discernible proof of the pudding is as intangible as is true with us."

". . . of course, the outstanding development in recent years, from the standpoint of the railroad industry, has been the standardized diesel locomotive. Certainly the initial price of a machine, which performs transportation service at something less than half the maintenance and operating expense of a comparable steam locomotive, would be materially increased if the builder's price had to reflect the engineering and production costs of meeting individual specifications from 130 Class I Railroads."

The writer of the foregoing letter estimated that the increased cost of a nonstandard diesel locomotive would be approximately 25 percent. This figure was confirmed by the representative of the largest builder of diesel locomotives, who stated that the last quotation to a railroad on a nonstandard locomotive was exactly 25 percent more than the quotation on a standard locomotive of the same capacity. The representative further stated that the increased cost would now be even greater because of the present complete mechanization and standardization of his Company's factory for mass production, which would be disrupted by attempting to produce nonstandard locomotives.

Chemical Industry

A chemical manufacturing company which has recently passed through a period of rapid growth writes:

CASE 135 "In our own Department (General Engineering), standard methods of process design, engineering design, symbols, and equipment standardization have saved money, how much is not known. Standards for safety and fire prevention and the design of the equipment therefor have saved an uncalculated amount of money.

"Standardization of accounting procedures, payroll handling, etc is a money saver. Savings are being made by standardization in finished goods inventories and, of course, a very large saving is being made by standardization of containers and shipping methods.

"Standardization of chemical equipment is in its infancy, but even there, standardization in, for instance, glass-lined vessels, steam ejectors, etc is beginning to make itself felt economically. We use standards on piping, insulation, painting, etc, and know that this is resulting in a saving."

Electrical Industry

A manufacturer of electrical wires and cables writes:

CASE 136 "Unfortunately we have no data available regarding the benefits derived from standardization. However, those of us who are in manufacturing are well aware of the benefits which we have derived and may still expect to receive from continued standardization of both raw materials and finished products."

Miscellaneous

A firm of consulting management engineers submits the following examples of savings resulting from standardization:

CASE 137 In a watch factory inventories of work-in-process were reduced 11 percent while sales increased 70 percent. Annual inventory turnover increased .88.

CASE 138 In a textile machinery factory, stores inventories were reduced 9 percent within a space of four months.

CASE 139 In a factory manufacturing cooking utensils, the reduction of storage and warehousing costs amounted to $184,716.

Steel Production

One of the largest steel producers has submitted the following recent (1951) example of savings from the use of standards for alloy steels:

CASE 140 "In steelmaking, excellent headway has been made in the adoption of standards for analysis ranges and hardenability limits for alloy steels. Certain of these standards are sufficiently close to one another that a given heat of steel, varying slightly from an intended range or limit, may be transferred to another application, the standards for which fit the heat involved. For example, at one plant in the period of January 1 to May 10, 1951, there occurred the following savings resulting from the existence of established standards for alloy steels:

Heats produced	816
Off-standard	64 or 7.85%
Heats rejected without application	7 or 0.86%
Heats that would have been rejected except for existence of closely similar standards	57 or 6.99%

We feel that the savings indicated (6.99 percent of the heats made during the period January 1 to May 10, 1951) were the combined result of the adoption of industry and company standards."

New ASA Members Since January First 1951

Maurice Stanley, Chairman of Fafnir Bearing Company and Chairman of the Membership Development Committee of ASA's Board of Directors, reports nearly 100 organizations affiliating with the Association since January 1. Serving with Mr. Stanley on the Committee are L. S. Corey, President, Utah Construction Company, R. M. Gates, President of Air Preheater Corporation, B. S. Voorhees, Vice President of the New York Central System and T. D. Jolly, Vice President of the Aluminum Company of America.

The Committee has been active in a continuing program to enlist industry support of the ASA through a broadened membership base. Some 2,300 companies and over 100 trade associations, technical societies and consumer organizations are now enrolled. The following list of new members represents a significant cross section of industrial activity and geographical location.

A-P Controls Corporation, Milwaukee, Wisconsin

Aetna Steel Products Corporation, New York, New York

The Air Preheater Corporation, New York, New York

Allied Chemical & Dye Corporation, New York, New York

American Cyanamid Company, New York, New York

Anemostat Corporation of America, New York, New York

*Atlas Powder Company, Wilmington, Delaware

Bearings Company of America, Lancaster, Pennsylvania

The Black & Decker Manufacturing Company, Towson, Maryland

Botany Mills, Incorporated, Passaic, New Jersey

The William J. Burns International Detective Agency, Incorporated, New York, New York

Calaveras Cement Company, San Francisco, California

Clayton & Lambert Manufacturing Company, Louisville, Kentucky

Colonial Supply Company, Pittsburgh, Pennsylvania

Continental Electric Company, Incorporated, Newark, New Jersey

A. B. Dick Company, Chicago, Illinois

Eugene Duklauer, Incorporated, New York, New York

Electran Manufacturing Company, Chicago, Illinois

Electrolux Corporation, New York, New York

Electronics Mechanics, Clifton, New Jersey

Fischbach & Moore, Incorporated, New York, New York

Franklin Electric Company, Incorporated, Bluffton, Indiana

Gavitt Manufacturing Company, Incorporated, Brookfield, Massachusetts

The General Builders Supply Corporation, New York, New York

Gillette Safety Razor Company, Boston, Massachusetts

*B. F. Goodrich Chemical Company, Akron, Ohio

*Special Contribution

Goodyear Tire & Rubber Company, Akron, Ohio

The Griscom-Russell Company, New York, New York

Gray Manufacturing Company, Hartford, Connecticut

C. E. Halback & Company, Brooklyn, New York

The Harshaw Chemical Company, Cleveland, Ohio

Hercules Powder Company, Incorporated, Wilmington, Delaware

Hooker Electrochemical Company, Niagara Falls, New York

Kaiser Aluminum & Chemical Corporation, Newark, Ohio

Kennametal, Incorporated, Latrobe, Pennsylvania

Leslie Company, Lyndhurst, New Jersey

Lipsky & Rosenthal, Incorporated, Brooklyn, New York

J. Livingston & Company, New York, New York

MacKenzie Muffler Company, Incorporated, Youngstown, Ohio

Magma Copper Company, New York, New York

The W. L. Maxson Corporation, New York, New York

Mine Safety Appliances Company, Pittsburgh, Pennsylvania

Minnesota Mining & Manufacturing Company, St. Paul, Minnesota

Monsanto Chemical Company, St. Louis, Missouri

The Morgan Engineering Company, Alliance, Ohio

National Aluminate Corporation, Chicago, Illinois

New Holland Machine Company, Division of Sperry Corporation, New Holland, Pennsylvania

New York Transformer Company, Incorporated, Alpha, New Jersey

Ohio-Apex, Incorporated, Nitro, West Virginia

Oldbury Electro-Chemical Company, Niagara Falls, New York

Parker Appliance Company, Cleveland, Ohio

Peerless Cement Corporation, Detroit, Michigan

Pennsalt International Corporation, Philadelphia, Pennsylvania

Chas. Pfizer & Company, Incorporated, Brooklyn, New York

Portland Gas & Coke Company, Portland, Oregon

Publicker Industries, Incorporated, Philadelphia, Pennsylvania

Riggs Distler & Company, Incorporated, Baltimore, Maryland

Royce Chemical Company, Carlton Hill, New Jersey

Saco-Lowell Shops, Boston, Massachusetts

William J. Scully, Incorporated, New York, New York

Service Tools Institute, New York, New York

Shell Chemical Corporation, New York, New York

William Somerville, Incorporated, New York, New York

Southern Illinois University, Carbondale, Illinois

Tennessee Products & Chemical Corporation, Nashville, Tennessee

Texas Steel Company, Fort Worth, Texas

Tung-Sol Lamp Works, Incorporated, Newark, New Jersey

The Tremco Manufacturing Company, Cleveland, Ohio

Trubek Laboratories, Incorporated, East Rutherford, New Jersey

University of California, Berkeley, California

(*Continued on page 342*)

Second National Standardization Conference

...sponsored by the American Standards Association in conjunction with its 33rd ANNUAL MEETING

Monday - Wednesday, October 22-24, The Waldorf-Astoria, New York

Theme: Strengthening America Through Standards

Monday, October 22

10:00 a.m. Jade Room

33rd Annual Meeting Session

Joint Meeting of ASA Board of Directors and Standards Council, Company Members and guests.

Presiding: Thomas D. Jolly, Vice-President, Aluminum Company of America; President of ASA

Reports: Vice Admiral G. F. Hussey, Jr., Managing Director of ASA

Walter C. Wagner, Philadelphia Electric Company, Chairman, ASA Standards Council

Keynote Address

"Strengthening America Through Standards"

Speaker:

D. A. Hulcy, President U. S. Chamber of Commerce; President, Lone Star Gas Company, Dallas, Texas

2:00 p.m. Jade Room

Industrial Standards for Defense Production

Sponsored by the American Ordnance Association

Moderator:

Louis Polk, President, The Sheffield Corporation, Dayton, Ohio; Vice-President, American Ordnance Association

Members of the Panel:

Dean K. H. Condit, School of Engineering, Princeton University, Princeton, New Jersey

Merle H. Davis, Brigadier General, USA, Chief, Ammunition Branch, Office of the Chief of Ordnance, U. S. Army, Washington, D. C.

William C. Newberg, President, Dodge Division, Chrysler Corporation, Detroit, Michigan

Dale Roeder, Executive Engineer, Commercial Vehicles, Ford Motor Company, Dearborn, Michigan

Donald A. Quarles, Bell Telephone Laboratories, New York, N. Y.

M. F. Schoeffel, Rear Admiral, USN, Chief of the Bureau of Ordnance, USN, Washington, D. C.

R. C. Sogge, General Electric Company, Schenectady, New York

James L. Walsh, President, American Ordnance Association, Washington, D. C.

Tuesday, October 23

10:00 a.m. Astor Gallery

Standards for Purchasing and How to Use Them

Sponsored by the Committee on Standardization of the National Association of Purchasing Agents.

Presiding: Vincent deP. Goubeau, Vice-President in Charge of Materials, RCA Victor Division, Radio Corporation of America, Camden, N. J.

10:00 a.m. Jade Room

Conference of Executives of Organization Members of ASA (CEOM)

Chairman: W. J. Donald, Managing Director, National Electrical Manufacturers Association

10:00 a.m. Basildon Room

ASA Company Member Conference

Presiding: W. P. Kliment, Crane Company, Chicago, Illinois

The Relation of Underwriters to ASA. *Presented by* Merwin Brandon, Vice-President, Underwriters' Laboratories, Inc., New York

Many safety codes and codifying bodies today require that products and equipment have the approval, re-examination service marker, or label of the Underwriters' Laboratories, Inc. In conducting approval tests and listing of appliances and materials, specifications and standards play an important part. Mr. Brandon will explain how Underwriters' Laboratories Standards are prepared, how they differ in some respects from American Standards and how standards are applied in test requirements for practical application in their testing stations and at the factories of various subscribers to their services.

Railway Research Promotes Standardization. *Presented by* Gerald M. Magee, Research Engineer, Association of American Railroads, Chicago, Illinois

The Association of American Railroads acts on matters of common interest to the railway industry, such as research pertaining to design and specifications for practically all track and equipment components. Mr Magee directs the research activities of the Association with respect to Way and Structures and has a great deal of experience in application of standardization practices to railroading.

The Role of Administrative Standards in Business and Industry. *Presented by* L. M. Dalcher, Superintendent of Standards and Publications, Fairbanks, Morse & Company, Beloit, Wiscon.

The term "administrative standards" is new in the field of standardization. The use of such standards and their coordination with technical standards play a major

role in today's accelerated business and engineering. Mr Dalcher will discuss the advantages of administrative standards, as well as ramifications involved in their use —planning, policymaking, etc.

Methods of Evaluating Savings from Standarization. *Presented by* R. J. Bisbee, Manager, Quality Control, Westinghouse Electric Corporation, Mansfield, Ohio.

The National Safe Transit Committee, of which Mr Bisbee is chairman, is responsible for a voluntary cooperative program for the reduction of packaging and shipping losses in the home appliance and allied metal products field. . Standards have been developed by the committee for preshipment testing of packaged products, which has resulted in great savings to manufacturers. Examples of evaluating savings from standardization will be presented with slides and movies.

Company Member Conference in Operation. *An Open discussion.*

CMC members are invited to present their needs, problems, and suggestions for development, application, and improvement of American Standards.

2:00 p.m. Jade Room

Finance Committee Meeting with ASA Members

Presiding: H. S. Osborne, Chief Engineer, American Telephone and Telegraph Company, N. Y.; Chairman, ASA Finance Committee.

Presentation of ASA's "Blueprint for 1952 — Program of Activities, Budget and Financing Plan."

2.00 p.m. Basildon Room

ASA Company Member Conference *(continued)*

Wednesday, October 24

10:00 a.m. Basildon Room

Standards Council

Presiding: Walter C. Wagner, Philadelphia Electric Company

Special Presentation: "Standards That Affect You and Me"

10:00 a.m. Jade Room

Materials Conservation Forum

Sponsored by *Modern Industry*

Moderator:

Eldridge Haynes, President and Publisher, *Modern Industry*

Panel

C. W. Bryan, Jr., President, Pullman-Standard Car Company

D. A. Hulcy
Keynote Speaker

Mr Hulcy is president of the U.S. Chamber of Commerce. He has been president of the Lone Star Gas Company, one of the largest public service organizations in the Southwest, for the past ten years.

Robert W. Wolcott, Chairman of the Board, Lukens Steel Company

Government spokesman: to be announced

12:30 p.m. Starlight Roof

Annual Meeting Luncheon

Presiding:

Thomas D. Jolly, President of the American Standards Association and Vice-President of Aluminum Company of America

Presentation of The Standards Medal —First Award

Recipient to be announced.

Presentation of the Howard Coonley Medal

Acceptance by the

HONORABLE HERBERT HOOVER

2:30 p.m. Palm Room

Board of Directors Meeting

Louis Polk

Moderator for the session on "Industrial Standards for Defense Production"

Mr Polk, vice-president of the American Ordnance Association, is president of The Sheffield Corporation of Dayton, Ohio, a leading producer of gaging machines, precision measuring instruments, and machine tools.

Program Committee
Chairman

Thomas D. Jolly, President of ASA, Vice-President of Aluminum Company of America

C. W. Bryan, Jr., President, Pullman-Standard Car Manufacturing Company

W. J. Donald, Managing Director, National Electrical Manufacturers Association

E. H. Eacker, President, Boston Consolidated Gas Company

Roger E. Gay, President, The Bristol Brass Corporation

Vincent deP. Goubeau, Vice-President, RCA Victor Division, Radio Corporation of America

W. P. Kliment, Crane Company

F. R. Lack, Vice-President, Western Electric Company

A new feature will be exhibits showing use of American Standards, prepared by companies in the photographic and piping industries. You will want to visit the Basildon Room where these exhibits will be on display.

AMERICAN STANDARDS

Status as of September 4, 1951

Legend

Standards Council — Approval by Standards Council is final approval as American Standard; usually requires 4 weeks

Board of Review—Acts for Standards Council and gives final approval as American Standard; action usually requires 2 weeks

Correlating Committees — Approve standards to send to Standards Council or Board of Review for final action; approval by correlating committee usually takes 4 weeks

Building

American Standards Just Published—

Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field ASTM C31-49; ASA A37.17-1951 $.25

Method of Test for Compressive Strength of Molded Concrete Cylinders ASTM C39-49; ASA A37.18-1951 $.25

Method of Test for Organic Impurities in Sands for Concrete ASTM C40-48; ASA A37.19-1951 $.25

Methods of Securing, Preparing and Testing Specimens from Hardened Concrete for Compressive and Flexural Strengths ASTM C42-49; ASA A37.20-1951 $.25

Method of Test for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading) ASTM C78-49; ASA A37.22-1951 $.25

Method of Test for Compressive Strength of Concrete Using Portions of Beams Broken in Flexure (Modified Cube Method) ASTM C116-49; ASA A37.24-1951 $.25

Method of Test for Amount of Material Finer Than No. 200 Sieve in Aggregates ASA A37.4-1951 (ASTM C117-49; Revision of ASA A37.4-1943 R 1948) $.25

Method of Measuring Length of Drilled Concrete Cores ASTM C174-49; ASA A37.31-1951 $.25

Method of Test for Penetration of Bituminous Materials ASTM D5-49; ASA A37.1-1951 $.25

Definition of Terms Relating to Materials for Roads and Pavements ASTM D8-49; ASA A37.33-1951 $.25

Method of Sampling Stone, Slag, Gravel, Sand and Stone Block for use as Highway Materials ASTM D75-48; ASA A37.75-1951 $.25

Specifications for Calcium Chloride ASTM D98-48; ASA A37.37-1951 $.25

Method of Testing Emulsified Asphalts ASTM D244-49; ASA A37.42-1951 $.25

Method of Float Test for Bituminous Materials ASTM D139.49; ASA (37.2-1951 $.25

Methods of Sampling and Testing Calcium Chloride ASTM D345-48; ASA A37.44-1951 $.25

Specification for Asphalt Plank ASTM D517-50; ASA A37.48-1951 $.25

Method of Test for Sulfonation Index of Road Tars ASTM D872-48; ASA A37.59-1951 $.25

Specification for Emulsified Asphalt ASTM D977-49; ASA A37.55-1951 $.25

Method of Test for Toughness of Rock, A37.73-1951 (ASTM D3-18; formerly ASA A5-1930) $.25

Specifications for Materials for Cement Grout Filler for Brick and Stone Block Pavements A37.74-1951 (ASTM D57-29; formerly ASA A31-1924) $.25

Sponsor: American Society for Testing Materials

Consumer

Standard Definitions of Terms Relating to Textile Materials (ASTM D 123-50; Revision of ASA L14.12-1951)

Standard Method of Test for Hard Scoured Wool in Wool in the Grease (ASTM D 584-50; Revision of ASA L14.40-1949)

Standard Methods of Testing Felt (ASTM D 461-50; Revision of ASA L14.52-1951)

Tentative Methods of Test for Fineness of Wool (ASTM D 419-50 T; Revision of ASA L14.26-1949)

Tentative Methods of Test for Fineness of Wool Tops (ASTM D 472-50 T; Revision of ASA L14.29-1949)

Tentative Methods of Test for Asbestos Yarns (ASTM D 299-50 T; Revision of ASA L14.18-1951)

Tentative Methods of Testing and Tolerances for Glass Yarn (ASTM D 578-50 T; Revision of ASA L14.36-1951)

Standard Recommended Practice for a Universal System of Yarn Numbering (ASTM D 861-50; Revision of ASA L14.48-1949)

Sponsors: American Association of Textile Chemists and Colorists; American Society for Testing Materials

Electrical

In Board of Review—

Preferred Voltage, 100 Volts and Under, C67.1

Sponsor: Electrical Standards Committee

Specifications for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft (ASTM B8-50; ASA C7.8)

Specifications for Soft Rectangular and Square Bare Copper Wire for Electrical Conductors (ASTM B48-49; ASA C7.9)

Specifications for Hard-Drawn Copper Alloy Wires for Electrical Conductors (ASTM B105-49; ASA C7.10)

Specifications for Figure-9 Deep-Section Grooved and Figure-8 Copper Trolley Wire for Industrial Haulage (ASTM B116-49; ASA C7.11)

Tentative Specifications for Rope-Lay Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors (ASTM B172-50T; ASA C7.12)

Tentative Specifications for Rope-Lay Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors (ASTM B173-50T; ASA C7.13)

Tentative Specifications for Bunch-Stranded Copper Conductors for Electrical Conductors (ASTM B174-50T; ASA C7.14)

Specifications for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes (ASTM B189-50; ASA C7.15)

Specifications for Cored, Annular, Concentric-Lay-Stranded Copper Conductors (ASTM B226-50; ASA C7.16)

Specifications for Hard-Drawn Copper-Covered Steel Wire (ASTM B227-49; ASA C7.17)

Specifications for Concentric-Lay-Stranded Copper-Covered Steel Conductors (ASTM B228-49; ASA C7.18)

Specifications for Concentric-Lay-Stranded Copper and Copper-Covered Steel Composite Conductors (ASTM B229-49; ASA C7.19)

Tentative Specifications for Hard-Drawn Aluminum Wire for Electrical Purposes (ASTM B230-50T; ASA C7.20)

Specifications for Concentric-Lay-Stranded Aluminum Conductors, Hard-Drawn (ASTM B231-49; ASA C7.21)

Tentative Specifications for Concentric-Lay-Stranded Aluminum Conductors, Steel-Reinforced (ACSR), (ASTM B232-50T; ASA C7.22)

Specifications for Rolled Aluminum Rods (EC Grade) for Electrical Purposes (ASTM B233-49; ASA C7.23)

Method of Test for Resistivity of Electrical Conductor Materials (ASTM B193-49; ASA C7.24)

Specifications for Hard-Drawn Copper Wire (originally ASTM B1-40; ASA H4.2-1941) (now ASTM B1-49; ASA C7.2)

Specifications for Medium-Hard-Drawn Copper Wire (originally ASTM B2-40; ASA H4.3-1941) (now ASTM B2-49; ASA C7.3)

Specifications for Tinned Soft or Annealed Copper Wire for Electrical Purposes (originally ASTM B33-46; ASA H4.4-1947) (now ASTM B33-50; ASA C7.4)

Specifications for Bronze Trolley Wire (originally ASTM B9-46; ASA H4.5-1947) (now ASTM B9-49; ASA C7.5)

Specifications for Copper Trolley Wire (originally ASTM B47-46; ASA H4.6-1947) (now ASTM B47-49; ASA C7.6)

Specifications for Hot-Rolled Copper Rods for Electrical Purposes (originally ASTM B49-41; ASA H4.7-1942) (now ASTM B49-50; ASA C7.7)

Sponsor: American Society for Testing Materials

Reaffirmation Requested—

American Standard Specifications for Soft or Annealed Copper Wire (ASTM B3-45; ASA H4.1-1947) (now ASA C7.1)
Requested by: American Society for Testing Materials

In Correlating Committee—

Attachment Plugs and Receptacles, C73b (Addition to, and partial revision of, C73-1941)
Sponsor: National Electrical Manufacturers Association

Graphical Symbols

In Board of Review—

Graphical Symbols for Single (One) Line Electrical Engineering Diagrams, Z32.1.1
Sponsors: American Institute of Electrical Engineers; American Society of Mechanical Engineers

Highway Traffic

In Correlating Committee—

Adjustable Face Traffic Control Signal Head Standards, D10.1 (Revision of D10.1-1942)
Sponsor: Institute of Traffic Engineers

Mechanical

In Board of Review—

Screw Thread Gages and Gaging, B1.2 (Revision of B1.2-1941)
Sponsors: American Society of Mechanical Engineers; Society of Automotive Engineers

In Correlating Committee—

Bearing Mounting Accessories, B3.9
Sponsor: Mechanical Standards Committee
Ring-Joint Gaskets and Grooves for Steel Pipe Flanges, B16.20
Sponsors: American Society of Mechanical Engineers; Heating, Piping, and Air Conditioning Contractors National Assn; Manufacturers Standardization Society of the Valve and Fittings Industry

Mining

In Board of Review—

Safety Code for Installing and Using Electrical Equipment In and About Coal Mines, M2.1 (Revision of M2-1926)
Sponsors: American Mining Congress; Bureau of Mines, U. S. Department of Interior

Safety

In Correlating Committee—

Code for Forging and Hot Metal Stamping, B24.1 (Revision of B24-1927)
Sponsors: Drop Forging Association; National Safety Council

What's New on American Standard Projects

Pipe Flanges and Fittings, B16—

Sponsors: American Society of Mechanical Engineers; Heating, Piping and Air Conditioning Contractors National Association; Manufacturers Standardization Society of the Valve and Fittings Industry

The B16 committee is planning to revise the American Standard Face-to-Face Dimensions of Ferrous Flanged and Welding End Valves, B16.10-1939 R1947, in order to expand the size range of some of the tables with the possibility of adopting the MSS SP-42 dimensions for the smaller size valves, and adopting dimensions which are quite uniformly used by the valve industry for sizes up to 24 inches. Consideration is also being given to a table of standard dimensions for the pressure-seal type of valve and a table to cover face-to-face dimensions for single seat pressure reducing valves.

Safety Code Correlating Committee—

Requests for two new safety projects have been received by the American Standards Association—one on equipment and clothing which may represent accident hazards to children, and the other on signaling devices and controls for printing presses and bindery machinery. The American Academy of Pediatrics submitted the proposal for the project on hazards to children, while the National Safety Council requested work on a printing safety code.

A general conference will be held to discuss each of these subjects. National organizations known to have an interest in them will be invited to the conferences to determine whether or not there is a consensus in favor of their initiation. Each of the conferences will determine whether such a project should be initiated; if so, its scope; and what organizations should be invited to sponsor such a project.

Standardization and Unification of Screw Threads, B1—

Sponsors: American Society of Mechanical Engineers; Society of Automotive Engineers

The new chairman and vice-chairman respectively of Committee B1 are: Frank P. Tisch, chief product engineer, Pheoll Manufacturing Co, Chicago, Ill., and W. H. Gourlie, standards engineer, The Sheffield Corp, Dayton, Ohio. Walter R. Penman, general manager of the Bethlehem Steel Co, Bethlehem, Pa, is continuing as secretary of the committee.

Films, Plates, and Papers, PH1—

Sponsor: Photographic Standards (Correlating) Committee

A conference on dimensions for film spools, leaders, trailers, and roll film for aerial photography was held recently at ASA headquarters. The purpose of the conference was to broaden the base of the work of Subcommittee PH1-1, Dimensions of Films and Plates, in order to include a wide representation from those concerned with all aspects of aerial film—both users and manufacturers of equipment.

Proposed revisions of the eight American Standards for Aerial Film Spools were discussed. After improvements and additions were made, the conference agreed that the standards were ready for submission to PH1 for recommendation on approval as revised American Standards.

The situation with regard to the standardization of three new sizes of aerial film spools—70-Mm, 5-Inch, and 18½-Inch—was also discussed. The group agreed that national standards should not be set up for these sizes until after practical experience had been gained through the production and use of these products. Subcommittee PH1-1 will handle this work when the development has proceeded to a point which would permit such action.

A new draft of the proposed revision of the American Standard Dimensions for Leaders, Trailers, and Roll Film for Aerial Photography, Z38.1.41-1944, was agreed to, and will be circulated to all concerned for comment and criticism.

Members

(*Continued from page 337*)

Watson Flagg Machine Company, Paterson, New Jersey

Wesson Company, Ferndale, Michigan

Welding Picture Productions, Incorporated, Chicago, Illinois

Whitin Machine Works, Whitinsville, Massachusetts

Wolff & Munier, Incorporated, New York, New York

New Member Bodies

Diesel Engine Manufacturers Association, Chicago, Illinois

Synthetic Organic Chemical Manufacturers Association, New York, New York

New Associate Members

American Ordnance Association, Washington, D. C.

Association of Roller & Silent Chain Manufacturers, Indianapolis, Indiana

Insulated Power Cable Engineers Association, Montclair, New Jersey

National Concrete Masonry Association, Chicago, Illinois

National Restaurant Association, Chicago, Illinois

National Tool & Die Manufacturers Association, Cleveland, Ohio

Pipe Fabrication Institute, Pittsburgh, Pennsylvania

Society of Naval Architects & Marine Engineers, New York, New York

Spring Washer Institute, New York, New York

• • **R. A. Colgan, Jr.,** member of ASA's Board of Directors, has resigned as executive vice-president of the National Lumber Manufacturers Association. He is to manage 600,000 acres of forest property for the Shasta Forest Company, with headquarters at Redding, California. Because of his outstanding leadership in forest conservation, Mr Colgan was named an honorary vice-president of the American Forestry Association this year.

News Briefs

• • **The first meeting** of its Aircraft Standards Coordinating Committee has been reported by the Standards Association of Australia. The committee plans to supervise and coordinate preparation of a series of Australian standards in the aircraft field to "place the industry on a sound basis before another emergency" arises. It was proposed that new standards be developed on aircraft cables and tires, in addition to work already going on covering synthetic rubber hose, aircraft accumulators, electric cables, and aircraft materials.

• • **The Carpenter Steel** Company has issued a set of data sheets giving information about Schedule 5 stainless steel pipe, the new light-walled pipe recently recommended by the Chemical Industry Correlating Committee. Copy of the data sheets can be secured from the company's Alloy Tube Division, Union, N. J.

• • **Only about one-fourth** of the 12,000 to 15,000 elevators in Tennessee are insured and only Nashville and Memphis, of the state's major cities, have local elevator inspection boards, according to Lynn C. Peal, chief state boiler inspector. Mr Peal has been employed by the newly formed State Elevator Inspection Bureau to head up its inspection staff.

James Lee Case, state labor commissioner, chairman of the bureau, said that rules and regulations, conforming to the American Standard elevator safety code will be distributed by the bureau at an early date.

• • **Model forms for boys' apparel** have now been standardized, the Commodity Standards Division, Office of Industry and Commerce, U.S. Department of Commerce, reports. A recommended Commercial Standard, TS-4640, has been endorsed by the model form industry. Measurements are based on the "height-weight" system of body measurement sizing given in Commercial Standard CS 155-50. This standard has been endorsed by the knit underwear, shirt, trouser, and sports-outerwear segment of the boys' apparel industry.

The model forms standard was proposed by the Limited Price Variety Stores Association, Inc., and the Mail Order Association of America.

• • **Nicholas E. Golovin** has been appointed Assistant Director for Administration of the National Bureau of Standards. Mr Golovin will be concerned with the planning and administrative management functions necessary for adequate support of the technical programs of the National Bureau of Standards. Mr Golovin left the position of Executive Assistant to the Director of NBS early in 1951 to manage the activation of the Corona Laboratories of NBS in Corona, California.

Prior to joining the National Bureau of Standards in April 1949, Mr Golovin was Head of the Management Division on the Staff of the Commander, Naval Ordnance Test Station, Inyokern, California.

• • **A. H. Baum, past president** of the Building Officials Conference of America, has been elected chairman of the Joint Committee on Unification of Building Codes. Mr Baum succeeds W. E. Mallalieu who recently retired as general manager of the National Board of Fire Underwriters, New York. Gilbert R. Barnhart, Housing and Home Finance Agency, Washington, D. C., was elected secretary succeeding John B. Courtney of the American Standards Association. Mr Courtney was at-

tending the March meeting of the committee when he died.

• • **The American Psychological Association** has endorsed the three new American Standards for measuring and specifying color, and is recommending their use by interested members of the Association. "The American Psychological Association is aware of the valuable contributions made by ASA," declared Fillmore H. Sanford, Executive Secretary of the Association. Mr Sanford spoke on behalf of his Board of Directors. The standards recommended are American Standard Method of Spectrophotometric Measurement of Color, Z58.7.1-1951; American Standard Method for Determination of Color Specifications, Z58.7.2-1951; Alternative Methods for Expressing Color Specifications; Z58.7.3-1951.

• • **A request for U.S. comment** on a draft specification for cotton dungaree cloth has officially opened correspondence between the recently organized Institute of Industrial Research and Standards of Ireland and the American Standards Association. The Institute is expected to become a member of the International Organization for Standardization in the near future. Copies of the draft specification have been circulated to groups concerned in this country for comment.

• • **The new American Standard** Building Code Requirements for Reinforced Concrete, A89.1-1951, just approved by the American Standards Association, is a revision of American Concrete Institute's standard 318-47, American Standard A89.1-1948.

Changes have been made to allow for the improved properties of new-style deformed reinforcing bars complying with ASTM Specification A305. The changes decrease the allowable bond stress in plain bars (including the old types of deformed bars) and increase the allowable bond stresses for the new types of bars over those previously allowed for the old types. Top bars, those having more than 12 inches of concrete under them, are assigned lower bond stresses than bars in other positions.

All plain bars must be hooked. This corresponds to special anchorage under the old provisions. The new bars develop sufficient anchorage by bond alone to correspond to special anchorage with the old type bars, resulting in less total steel required.

This standard was developed by a committee of the American Concrete Institute under the procedures of the American Standards Association. The Defense Production Authority has just announced that officials of 11 Federal agencies have agreed to abide by the provisions of this new edition.

"The notion of standards of quality and measurement dates back to the earliest times of British craftsmanship. In the merchant and craft guilds of the Middle Ages, long before the modern factory system was dreamt of, the members used to lay down collectively standards of quality and performance by which their work should be judged. They did this either to protect their own names as good craftsmen or to defend the fame of their locality, so that their reputations—and hence their employment—should not be damaged by shoddy goods."—*Fifty Years of British Standards.*

• • **Two important recommendations** for international use were approved by the Council of the International Organization for Standardization (ISO) at its recent meeting in Geneva, Switzerland, July 2 through 5. Vice-Admiral G. F. Hussey, Jr., managing director of the American Standards Association and United States representative on the Council reported on these recommendations upon his return from Europe. The American Standards Association is the United States member of the International organization.

The designation of twist for textile yarns as either "S" or "Z" depending upon the direction of turns of the yarns was the first ISO Recommendation. This recommendation has already been adopted as a national standard in twelve countries that are members of ISO/TC Committee 38 on Textiles: Belgium, Canada, Denmark, France, Italy, Netherlands, Norway, Sweden, Switzerland, United Kingdom, and the United States. The Bureau International Pour La Standardization des Fibres Artificielles, an international organization in the field of synthetic fibers, has also adopted the "S" and "Z" twist as its standard.

The second ISO Recommendation calls for the use of the standard reference temperature of 20 degrees Centigrade (68 degrees Fahrenheit) for the measurement of mechanical gages. This concerns the reference temperature for limit gages as generally used for the inspection of component parts in the mechanical and other industries. Since these parts and the gages change in size with variations in temperature (expanding with increasing temperature and contracting with decreasing temperature) it is necessary to have general agreement on the temperature at which their sizes will be acceptable. At present this Recommendation is already standard practice in all industrial countries.

There is no compulsion behind ISO recommendations. It is hoped that each of the 31 national standards bodies which now make up the membership of the ISO will adopt the recommendations as part of their own pertinent national standards, or if their standards already agree with the recommendations that they will so state in the standards. In this manner there will be nearly world wide uniformity on these standard basic terms.

The Council also voted unanimously to accept applications for membership in ISO from the national standards body of Spain (Instituto Nacional de Racionalizacion del Trabajo) and from the newly organized Pakistan Standards Institution. These admissions bring the ISO roster to 31.

When You Talk Acoustics Are You Up to Date?

In this rapidly developing new science, terms grow up like Topsy. Concepts have changed with the development of new knowledge in supersonics, ultrasonics, underwater sound, recording techniques, and medical science.

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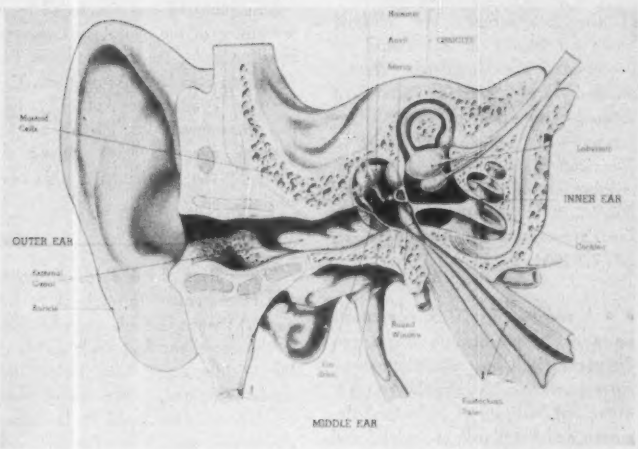
American Standard Acoustical Terminology Z24.1-1951



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Cross references to terms used in more than one section.

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Sponsored by the Acoustical Society of America in cooperation with the Institute of Radio Engineers, Inc., under the procedures of the American Standards Association.

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